DEPARTMENT OF MINES AND AGRICULTURE, SYDNEY.

RECORDS

OF THE

GEOLOGICAL SURVEY OF NEW SOUTH WALES,

VOL. IV.

1894-95.

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GEOLOGICAL SURVEY OF NEW SOUTH WALES.

Vol. IV.] 1894. [Part I.

I.—On the Discovery of Coal under Cremorne, Sydney Harbour: by T. W. E. David, B.A., F.G.S., Professor of Geology, Sydney University, and E. F. Pittman, A.R.S.M., Government Geologist.

[Plates I and II.]

I.—Introduction.

There is evidence to show that as long ago as 1847, the late Rev. W. B. Clarke believed in the existence of coal underneath Sydney, for in his evidence given in that year before the Select Committee of the Legislative Council on "Coal Inquiry," he said: "If we take a dip of only one degree from Newcastle to the south, and from Illawarra to the north, the synclinal curve will meet at the entrance to Broken Bay, which is exactly half way (the extremity probably of the minor axis) at a depth of 4,680 feet—*the depth of the coal seams if continuous.*"

Of late years the existence of coal under Sydney has been regarded by local geologists as almost a certainty, the only point in connection with it upon which there was any divergence of opinion being the depth at which it was likely to occur. The relation of the coal seams at Newcastle to those at Bulli was reported upon by one of the Authors in 1890*, and two theories as to the probable sequence

*Vide Report by T. W. E. David, B.A., F.G.S., Geological Surveyor. *Ann. Rept. Dept. Mines for* 1890 [1891], p. 234-235.

of the Permo-Carboniferous rocks under Sydney were discussed, and it is satisfactory to note that the theory then put forward as the most probable one has been substantially proved to be correct by the discovery of the Bulli seam in the diamond drill bore at Cremorne, lately finished under the supervision of Mr. W. H. J. Sleo, the Superintendent of Diamond Drills.

II.—*Details of Bores near Sydney.*

Quite a number of diamond drill bores have, within the last fourteen or fifteen years, been put down in or near Sydney with the object of proving the depth at which coal actually occurs. The following is a list of these bores in the order in which they were completed:—

(1.) *The Newington Bore.*—This was put down under the supervision of Mr. J. Coghlan, at Newington, on the Parramatta River, in 1878. This bore was abandoned at a depth of 1,312 feet without reaching coal. The chocolate shales were penetrated (according to Dr. J. C. Cox) at a depth of 1,100 feet. Scales of native copper were observed in the shales in this bore in 1878 by Mr. J. Waterhouse, M.A., but their horizon is probably considerably higher than that of the cupriferous tuffs proved in some of the later bores.

Previous References.—C. S. Wilkinson, Ann. Rept. Dept. Mines for 1878 [1879], p. 155.
S. L. Bensusan, Journ. R. Soc. N.S. Wales, 1878, XII., p. 254.
T. W. E. David, Proc. Austr. Assoc. Advt. Sci., 1888 [1889], I., p. 275.
T. W. E. David, Trans. Geol. Soc. Austr., 1888, I., Pt. 3, pp. 83-89.
J. C. Cox, Proc. Linn. Soc. N.S. Wales, 1881, V., Pt. 3, p. 274.

(2.) *Holt-Sutherland Bore*, No. 1 (*Botany*).—Mr. J. Coghlan.—This bore was abandoned in 1879 at a depth of 2,193 feet without having reached coal. The chocolate shales were penetrated at a depth of 880 feet.

Previous References.—Ann. Rept. Dept. Mines for 1879 [1880], p. 208.
Mineral Products, 2nd Ed., 1887, pl. 6.

(3.) *The Moore Park Bore.*—Was put down by Mr. J. Coghlan at a spot about half a mile southerly from the southern end of Bourke-street, and was abandoned in the year 1880 at a depth of 1,860 feet without reaching coal. The site was about twenty feet above sea level. The chocolate shales were struck at a depth of 1,043 feet.

Previous References.—C. S. Wilkinson, Ann. Rept. Dept. Mines for 1880 [1881], p. 241.
J. C. Cox, Proc. Linn. Soc. N.S. Wales 1881, V., Pt. 3, pp. 273-280.
R. Etheridge, Junr., Geol. Survey N.S. Wales, Pal. Mem., No. 1., 1888, pp. 1-4.

(4.) *Holt-Sutherland Bore, No.* 2 (*Botany*).—Mr. J. Coghlan.—On account of a broken boring tool becoming fixed in the bottom, boring operations were relinquished at a depth of 1,875 feet without coal being struck. The Authors are not aware of any previously published references to this bore.

(5.) *The Camp Creek Bore.*—This bore was also put down by Mr. J. Coghlan near the site where the Metropolitan Coal Company subsequently sank their main shaft at Helensburgh, on the Illawarra Railway line. The height of the site above sea level was 336 feet. The chocolate shales are here seen at the surface on the side of the range. The bore was completed in 1884, and was successful in reaching a seam of coal twelve feet thick at a depth of 846 feet.

Previous References.—C. S. Wilkinson, Ann. Rept. Dept. Mines for 1884 [1885], pp. 151-152.
J. Mackenzie, Ann. Rept. Dept. Mines for 1888 [1889], p. 146.

(6.) *The Heathcote Bore.*—This was completed in 1886 under the supervision of Mr. W. H. J. Slee, Superintendent of Diamond Drills. The site of this bore was opposite Mount Westmacott, and near the Waterfall Station, on the Illawarra Railway line. The site was four hundred and sixty-seven and a-half feet above sea level. The total depth bored was 1,586 feet, and two seams of coal were reached, viz., the upper seam four feet eight and a-half inches thick, at a depth of 1,513 feet, and the lower seam six feet one inch thick, at a depth of 1,577 feet 9 inches from the surface. The chocolate shales were struck at a depth of three hundred and seven feet from the surface. At depths of 1,065 feet and 1,072 feet tuffaceous shales containing scales of metallic copper were met with. A total thickness of seven inches of these shales were observed to be cupriferous.

Previous References.—Ann. Rept. Dept. Mines for 1885 [1886], p. 176.
T. W. E. David, Ann. Rept. Dept. Mines for 1887 [1888], p. 154.
T. W. E. David, Proc. Austr. Assoc. Advt. Sci., 1888 [1889], I., pp. 277, 281, 282, 288.
T. W. E. David, Trans. Geol. Soc. Austr., 1888, I., Pt. 3, pp. 82-89.
R. Etheridge, Junr., Geol. Survey N. S. Wales, Pal. Mem., No. 1, 1888, pp. 1, 4.

(7.) *Holt-Sutherland Bore, No.* 3 (*Dent's Creek*).—This bore was completed in 1887 under the supervision of Mr. W. H. J. Slee, Superintendent of Diamond Drills. The site of the bore was one hundred and thirty-two feet above sea level, and the total depth reached was 2,307 feet from the surface. The chocolate shales were struck at 787 feet, and two seams of coal were reached, the upper seam (four feet two inches thick) at a depth of 2,228 feet, and the lower (five feet three inches thick) at 2,296 feet 6 inches from the surface. At a depth of 1,764½ feet scales of metallic copper were met with in tuffaceous shales, the latter being first struck at a depth of 1,729 feet.

Previous References.—Ann. Rept. Dept. Mines for 1883 [1884], p. 197.
Ann. Rept. Dept. Mines for 1886 [1887], p. 189.
C. S. Wilkinson, Ann. Rept. Dept. Mines for 1887 [1888], p. 139.
T. W. E. David, Ann. Rept. Dept. Mines for 1887 [1888], pp. 153-154.
T. W. E. David, Proc. Austr. Assoc. Advt. Sci., 1888 [1889], I., p. 276.
T. W. E. David, Trans. Geol. Soc. Austr., 1888, I., Pt. 3, pp. 83-89.
R. Etheridge, Junr., Geol. Survey N. S. Wales, Pal. Mem., No. 1, 1888, pp. 1-4.

(8.) *The Narrabeen Bore.*—This was put down by Mr. J. Coghlan, to the west of Narrabeen Lagoon, about seven miles north of Manly Beach. The bore was abandoned at a depth of about 1,985 feet, without having reached coal. The site of this bore was about five feet above sea level. The chocolate shales were struck at a depth of three hundred and seventy-nine feet six inches, and the horizon of the cupriferous tuffs at 1,715 from the surface.

Previous References.—C. S. Wilkinson, Ann. Rept. Dept. Mines for 1885 [1886], p. 130.
C. S. Wilkinson, Ann. Rept. Dept. Mines for 1887 [1888], p. 137.
C. S. Wilkinson, Ann. Rept. Dept. Mines for 1889 [1890], p. 198.
R. Etheridge, Junr., Geol. Survey N. S. Wales, Pal. Mem., No. 1, 1888, pp. 1-4.
T. W. E. David, Ann. Rept. Dept. Mines for 1890 [1891], pp. 233, 235-237.

(9.) *The Rose Bay Bore.*—Mr. J. Coghlan put down this bore on the Cooper Estate, at Rose Bay, Sydney Harbour. Owing to the bore becoming blocked by a broken tool, operations were abandoned in 1888, the coal not having been reached.

The Authors are not aware of any previously published references to this bore.

(10.) *The Liverpool Moorebank Bore.*—Mr. J. Coghlan also started this bore, and carried it down to a depth of 1,485 feet, and it was subsequently finished under the supervision of Mr. W. H. J. Slee, Superintendent of Diamond Drills. The height of the site above sea level was about forty feet, and the total depth of the bore was 2,601 feet 6 inches. Three seams of coal were reached, the upper (one foot five inches thick) at a depth of 2,493 feet 6 inches, the second (one foot four inches thick) at a depth of 2,507 feet 7 inches, and the lowest (six feet six and a half inches thick) at 2,583 feet 4 inches from the surface.

Previous References.—Ann. Rept. Dept. Mines for 1889 [1890], pp. 136, 148.
Ann. Rept. Dept. Mines for 1890 [1891], pp. 138, 149.
T. W. E. David, Proc. Austr. Assoc. Advt. Sci., I., 1888 [1889], p. 288.
R. Etheridge, Junr., Geol. Survey N. S. Wales, Pal. Mem., No. 1., 1888, pp. 1-4.
T. W. E. David, Ann. Rept. Dept. Mines and Agric. for 1891 [1892], pp. 244-245.

(11.) *The First Cremorne Bore.*—This important bore was put down at Robertson's Point, Cremorne, Sydney Harbour, under the supervision of Mr. W. H. J. Slee, Superintendent of Diamond Drills. The site of the bore was fifty-four feet above sea level, and the total depth reached was 3,095 feet from the surface. The chocolate shales were struck at a depth of 943 feet 4 inches, and at a depth of 2,801 feet 9 inches, a seam of coal, which proved to be seven feet three and a half inches thick, was reached. The coal, however, was found to have been charred or partly converted into coke owing to the intrusion of two dolerite dykes. Previous

to reaching the coal seam the bore passed through two masses of dolerite, and a subsequent examination of the land in the vicinity of the bore revealed the course of the two dykes at the surface.

Previous References.—Ann. Rept. Dept. Mines for 1890 [1891], p. 163.
Ann. Rept. Dept. Mines and Agric. for 1891 [1892], p. 152, and diag. 11.

(12.) *The Second Cremorne Bore.*—After the course of the two dolerite dykes referred to above had been carefully determined, the site for the second Cremorne bore was chosen (by one of the Authors), as far away from both of them as the limits of the available land would allow.* This site was distant about forty chains in a direction north forty-six degrees west from the first bore. The height above sea level of the site of the second bore was one hundred and forty-three feet. Boring operations were commenced in July, 1892, under the supervision of Mr. W. H. J. Slee, Superintendent of Diamond Drills; and on the 9th November, 1893, a fine seam of coal, ten feet three inches thick and free from any alteration by contact with dykes, was penetrated. The depth of the bore from the surface to the roof of the coal-seam was 2,917 feet.

The following is a generalised section of the strata passed through in the bore :—

				Thickness. feet.	Thickness. inches.	Depth. feet.	Depth. inches.
Triassic	Hawkesbury Series	Hawkesbury Sandstones		1,020	6	1,020	6
		Narrabeen Beds...	(a) Chocolate shales	163	6	1,184	0
			(b) Sandstones, shales, and conglomerates, with *Thinnfeldia*, *Sphenopteris* (new species), *Macrotæniopteris*, *Odontopteris*, *Sagenopteris*, *Schizoneura*, and *Estheria*	1,112	6	2,296	6
			(c) Tuffaceous, dark green, gritty shales,—horizon of the cupriferous tuff of Holt-Sutherland (Dent's Creek) and Heathcote Bores	60	6	2,357	0
			(d) Sandstones, shales, and conglomerates, with concretions of clay ironstone from 2,868 to 2,899 feet	560	0	2,917	0
Permo-Carboniferous.	Newcastle Series		Coal seam	10	3	2,927	3
			Clay, shale, and mudstone, with *Vertebraria*	1	9	2,929	0

The following is a descending section of the seam :—

	ft.	in.
Roof—clay shale.		
Coaly clay shale	0	1
Splint coal, somewhat inferior, with minute veins of calcite	0	8
Coal, splint and bituminous, of good quality	2	10
Band, dark brown clay shale, adhering firmly to coal	0	0¼
Coal, splint and bituminous, of good quality, the last three inches rather soft and bituminous	6	4¼
Coal, soft, bituminous, a trifle clayey	0	3½
	10	3
Floor—Black carbonaceous clay shale, containing impressions of *Vertebraria*.		

* *Vide* Ann. Rept. Dept. of Mines and Agric. for 1892 [1893], pp. 109-110.

III.—Composition of the Cremorne Coal.

The following proximate analyses were made by Mr. J. C. H. Mingaye, F.C.S., Analyst and Assayer to the Department of Mines, of samples from different parts of the seam under Cremorne.

No. 1.—Average sample from first eighteen inches below the eight inches of coal with calcite veins.

Hygroscopic moisture	·65	
Volatile hydrocarbons	17·30	
Fixed carbon	71·75	Coke, 82·05 %
Ash	10·30	
	100·00	

Sulphur, ·795 %. Specific gravity, 1·207. Ash, reddish tinge, flocculent. One pound of this c al will convert 12·7 pounds of water into steam.

No. 2.—Average sample from the next eighteen inches.

Hygroscopic moisture	·70	
Volatile hydrocarbons	17·80	
Fixed carbon	71·60	Coke, 81·50 %
Ash	9·90	
	100·00	

Sulphur, ·562 %. Specific gravity, 1·365. Ash, reddish tinge, flocculent. One pound of this coal will convert 13·3 pounds of water into steam.

No. 3.—Average sample from the next fourteen inches.

Hygroscopic moisture	·80	
Volatile hydrocarbons	16·90	
Fixed carbon	71·05	Coke, 82·30 %
Ash	11·25	
	100·00	

Sulphur, ·617 %. Specific gravity, 1·398. Ash, reddish tinge, flocculent. One pound of this coal will convert 12·9 pounds of water into steam.

No. 4.—Average sample from the next fourteen inches.

Hygroscopic moisture	·70	
Volatile hydrocarbons	17·05	
Fixed carbon	71·25	Coke, 82·25 %
Ash	11·00	
	100·00	

Sulphur, ·802 %. Specific gravity, 1·374. Ash, reddish tinge, flocculent. One pound of this coal will convert 12·9 pounds of water into steam.

No. 5.—Average from the next fourteen inches.

Hygroscopic moisture	·65	
Volatile hydrocarbons	17·95	
Fixed carbon	70·15	Coke, 81·40 %
Ash	11·25	
	100·00	

Sulphur, ·878 %. Specific gravity, 1·373. Ash, reddish tinge, flocculent. One pound of this coal will convert 13·1 pounds of water into steam.

No. 6.—Average sample of the lowest fourteen inches of the seam.

Hygroscopic moisture	·45	
Volatile hydrocarbons	18·45	
Fixed carbon	71·75	Coke, 81·10 %
Ash	9·35	
	100·00	

Sulphur, ·686 %. Specific gravity, 1·362. Ash, reddish tinge, flocculent. One pound of this coal will convert 13·2 pounds of water into steam.

The mean of the foregoing six analyses gives the average composition of the entire seam as follows:—

Hygroscopic moisture	·66	
Volatile hydrocarbons	17·57	
Fixed carbon	71·09	Coke, 81·77 %
Ash	10·68	
	100·00	

Mean percentage of sulphur	·724
Mean specific gravity	1·346
Mean calorimetric value	13·00

The aggregate thickness of the coal represented by the above analyses does not equal the total thickness of the coal as given in the section of the seam, because some of the core was reduced to powder and lost during the boring operations.

It is evident from the above that the Cremorne seam consists of good coal especially suitable for steaming purposes, and that it is rather superior to the Illawarra or Southern coal, particularly in regard to the percentage of ash.

The temperature at the bottom of the bore was ascertained by one of the Authors, the apparatus employed being so constructed as to protect the thermometers from the great pressure due to the depth. When the experiments were made the lowest portion of the bore was found to be obstructed by caving, but at a depth of 2,733 feet the temperature was observed to be 97° Fah. If the mean annual temperature of Sydney be taken as 63°, and if the stratum of invariable temperature be assumed to be fifteen feet below the surface, this result will be found to be equal to an average increase of 1° Fah. for every eighty feet of descent, and at this rate the temperature of the earth's crust at the depth of the coal seam would be 99·8° Fah. It may, however, be noted that the experiments in connection with the temperature were made in a bore, the site of which was nearly one hundred and fifty feet above sea level, and as the working shaft of the colliery will probably be sunk at a spot very much closer to high-water mark the actual temperature of the coal seam is likely to be quite 1° less than that deduced from the experiments.

The ascertained temperature is much more favourable than could reasonably have been anticipated, as the average rate of increase of temperature in different parts of the world is 1° for every sixty-three feet in depth, and there is every reason to expect that, with the aid of the most modern ventilating appliances, the temperature of the coal workings under Sydney harbour will be reduced to about 80° Fah.

The positions of the different bores referred to in this paper are shown on Pl. II, and the approximate dips of the chocolate shales, the cupriferous tuffs, and the coal seam are given in two sections (Pl. I), viz., from Camp Creek northerly to Narrabeen, and from Liverpool north-easterly and easterly to Cremorne. The position of Wyong Creek is also shown, immediately to the north of which chocolate shales, similar to those of Narrabeen, outcrop in the railway cuttings.

II.—Columnar Structure in Quartz-Felspar Porphyry at Mount Hope, Co. Blaxland, N. S. Wales: by JOHN B. JAQUET, A.R.S.M., F.G.S., Geological Surveyor, and GEORGE W. CARD, A.R.S.M., F.G.S., Curator and Mineralogist.

ABOUT a mile distant, in a westerly direction from the South Copper-mine, in the vicinity of Mount Hope, a low hill, composed of quartz-felspar porphyry, is to be found intruding (?) clay-slates, which can be observed in some places at its base. The whole of the upper portion of the boss is marked out by joints into a system of hexagonal columnar blocks, and, in some places, owing to unequal denudation having occurred, the columns so exposed stand out above their neighbours. The greatest observed height of these columns above the general surface of the hill was six feet, while the width of the faces varies between one foot and eighteen inches. Some of them, as a result of weathering, have assumed rudely-pointed terminations.

From a description given by Mr. Cawse, General Manager of the Mount Hope Copper-mine, it would seem as if columns exhibiting a "cone-in-cone" structure could be seen at one time, but now every instance of this structure appears to have been effaced. During the period when the copper mines were being exploited on a large scale, and a considerable population was resident at Mount Hope, boys from this town were accustomed to resort to this hill and wedge out the columns with crowbars in order to watch them roll down its sides; the base of the hill is now strewn with the broken remains of columns sacrificed in this manner.

A subsequent examination of the prominent hill which overlooks from the west the township of Mount Hope, and is distant from it about a mile and a half, showed it also to consist of the porphyritic rock, with a system of hexagonal jointing.

The district was traversed in 1875* by the late Mr. Lamont H. Young, A.R.S.M., Geological Surveyor, and, according to the information supplied by him and charted on the Geological Map of the Colony, the porphyry covers a large area of country in the vicinity of Mount Hope.

The time at the disposal of the observer† for the purpose of investigating the relations existing between the sedimentary and igneous rocks was very limited; hence the Authors of this paper do not think they are warranted in speaking definitely as to whether the latter is intrusive or otherwise. However, if the

* Ann. Rept. Dept. Mines N.S. Wales for 1880 [1881], pp. 259-268.
† The rock was examined in the field by only one of the Authors.

detailed description of the rock, which is given hereafter, be referred to, it will be seen that, after consolidation, many of its component minerals have undergone considerable alteration, and these changes are of such a nature as could only have taken place at some depth beneath the earth's surface—they are not those that might reasonably be expected to result from weathering. Thus it would seem that the rock does not represent a much altered lava-flow of, comparatively speaking, recent origin; and, moreover, the fact that it has an acid composition, and is found over a large area, militates against any such hypothesis.

Where hexagonal jointing has been observed in rocks which undoubtedly represent consolidated lava-flows the longer axis of the columns are always arranged in a direction normal to the surface of cooling. Now, in the case under description, the columns are vertical, while the slates found as before mentioned at the bottom of one of the porphyry hills, and all the sedimentary rocks of Palæozoic age observed in the district, dip at a high angle; therefore, if, while denying the intrusive origin of the rocks, we admit, in order to satisfy the requirements which its altered condition demand, that it is an ancient lava-flow from which a vast amount of superincumbent rock has been removed by denudation, then it must have been poured out after the formation and subsequent upheaval of the Palæozoic rocks had been effected. Mr. Lamont H. Young assigned a Devonian age to the slates.*

Examined microscopically, the rock is seen to consist of a greyish base—which gives to it a prevailing grey tint, lighter on weathered surfaces—interbedded in which are many porphyritic crystals of felspar, quartz, and a soft blackish mineral. Quartz is present in the form of numerous glassy blebs. Felspar is very abundant; it is uniformly white in colour, and sometimes shows good cleavage-faces with a vitreous lustre; some of the crystals are of very considerable size. A very close connection is sometimes evident between the felspar and the soft blackish mineral referred to above. This latter occasionally forms complete pseudomorphs with approximately rectangular outlines. The rock is occasionally traversed by thin veins of calcite. The mean of several determinations made by the Curator's Assistant, Mr. L. F. Harper, gave a specific gravity of 2·65.

Two thin-sections have been prepared from the specimens available. A microscopic examination shows the base to be completely micro-crystalline, and to consist very largely of what is perhaps quartz. Microlites of what appears to be white mica occur occasionally. A sort of micropegmatitic structure is sometimes noticeable (Slide 428†), in which an angular fragment of quartz often constitutes a nucleus to a circular area which, to a large extent, extinguishes simultaneously with it. These areas may, perhaps, be analogous to spherulites.

* *Loc. cit.* p. 260.

† The numbers are those under which the microscope-slides are registered in the Collections of the Geological Survey of N.S. Wales.

Quartz.—This occurs as large, very much broken, often idiomorphic crystals, and as small angular fragments scattered through the base. The larger masses contain numerous glass-inclusions—some with fixed bubbles—and are also traversed by cracks along which numerous minute cavities are arranged. Slide 431 shows an inclusion of a mineral with pleochroism in green and white. There is no trace of undulatory extinction. The corrosion by the magma has been so very intense as to remind one of the similar phenomenon common in many rhyolites.

Felspar.—This mineral frequently occurs as idiomorphic crystals in which the characteristic faces of orthoclase are sometimes well-marked. Both simple and compound twinning may be noticed, but kaolinisation has usually advanced so far as to obliterate all such structures. A considerable development of epidote has gone on at the expense of the felspar. Greenish alteration products, in some cases apparently of a chloritic nature, are common. In one case a passage into what appears to be a white mica occurs.

In each section there is an instance of a fragment of felspar showing secondary growth. In one case (Slide 429), as shown in the figure, a rounded grain has added to its substance on all sides. Both newer and older portions are much kaolinised, the latter rather more than the former as might be expected. A narrow comparatively unaltered zone surrounds the kernel. Twin-lamellation is present; sometimes traversing the whole crystal from end to end, at others occurring only in the newer or the older portion and stopping abruptly on reaching the line of demarcation between them. A development of epidote has taken place in both portions.

Crystal of felspar in which two periods of growth are indicated. Certain of the twin-planes are seen to terminate on the line of division between the two portions. Patches of clear epidote are developed in places, and there is much cloudiness resulting from decomposition. Drawn from Slide 429, as seen between crossed nicols by an inch objective.

It would appear from this that, at an early stage in the history of the rock, it was subjected to conditions which were favourable to the separation of felspar. The kernel, rounded by prior corrosion, resumed its growth and added considerably to its bulk. Subsequently conditions of strain resulted in the development of twin-lamellation which affected both parts of the crystal indifferently; slight breaks in continuity (probably of a physical nature) at the boundary between the two portions sometimes determining the linear extension of the lamellæ. The whole crystal partakes of the alteration resulting from the action of the chemical agencies that have given rise to the development of kaolin and epidote.

In another instance (Slide 428) a crystal of felspar appears to have added to its bulk along two of the edges. As before, a development of kaolin and epidote occurs in poth portions, but the twinning phenomena are absent.

Green alteration products.—These are abundantly developed, and appear to be of a chloritic nature. They occur as minutely fibrous aggregates with a more or less radial structure scattered through the rock, or as compact pseudomorphs sometimes intimately associated with epidote and felspar. They are, if at all, very feebly pleochroic, and generally polarise in mottled neutral tints.* Occasionally patches of a pale brown pleochroic mineral (mica?) occur, and there is also a passage into what may be white mica. Closely associated with these green products is, here and there, a pale brown structureless mineral with a high refractive index, somewhat resembling sphene. It gives very vivid polarisation tints, and generally has an opaque yellowish product developed on it. This substance is also associated with epidote.

III.—Description of a Proposed New Genus of Rugose Coral (*Mucophyllum*): by R. ETHERIDGE, Junr., Palæontologist and Librarian.

[Plates III and IV.]

I.—Introduction.

AMONGST the corals of Silurian age recorded in lists of New South Wales fossils is ***Ptychophyllum patellatum***, Schl., and this reference has been confirmed by the late Prof. De Koninck, who described† a specimen from Dangelong.

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* The sections are very thin.
† Foss. Pal. Nouv.-Galles du Sud, Pt. 1, 1876, p. 11.

Ptychophyllum patellatum has never come under my notice, but a coral resembling it in general appearance, although differing considerably in minute points of structure, is met with in moderate quantity at several localities; this it is proposed to describe as *Mucophyllum crateroides.*

I have derived much assistance in unravelling the structure of this coral by reading a paper by Mr. W. H. Sherzer—"A Revision and Monograph of the Genus *Chonophyllum*"*—in which the relations of the last named, *Omphyma* and *Ptychophyllum*, and their delimitation, is fully discussed. His remarks are freely quoted. The difficulties attendant on a study of this group to one situated as the Writer is, far from typical specimens for comparison, and the more important works of reference, have not been lessened by the comparatively recent proposal on the part of Mr. G. Lindström† to merge *Ptychophyllum* in *Streptelasma.*

I purpose giving first a description of the Australian coral, and then comparing its structure with its nearest allies *Omphyma* and *Ptychophyllum*, Sherzer's researches rendering it necessary to say but little about *Chonophyllum.*

II.—Structure of MUCOPHYLLUM—*Gen. nov.*

In outward appearance *Mucophyllum* resembles *Ptychophyllum*, both possessing the same short mushroom-shaped sub-pedicillate corallum. The latter is briefly turbinate below with a short truncated base gradually expanding upwards and outwards, with gently curving concave sides, to a more or less circular periphery (Pl. III, Fig. 1). The upper surface is reflected to form either a horizontal or slightly outwardly curving expansion, giving to the whole corallum the appearance of a low-arched umbrella or mushroom, excavated in the centre, and gradually thinning off to the edge. This edge may be quite sharp and fine, or at times is substantially thick.

In one example the corallum immediately before approaching the edge is a quarter of an inch in thickness.

The size is variable, but specimens have been observed nearly five inches in diameter. The exterior of the corallum below the periphery is enveloped in a thin epitheceal covering, and anchoring tubular roots are given off at intervals.

The thin epitheceal covering hardly seems to amount to a true epitheca, and presents fine closely abutting concentric lines, which ride over but do not obliterate the costæ. Here and there one of these concentric lines is stronger and almost assumes the appearance of a lamina. At times, immediately around the circular periphery, they become festoon-shaped, and correspond to the imbricate corallum edge. The radii on the under-surface agree in position with the septa, and

* Bull. Geol. Soc. America, 1892, III, p. 253.
† Richthofen's Beiträge Pal. China, 1883, IV Abhandl., p. 65.

correspond to the re-entering angles of the festooned edge, and are therefore "costæ" as distinguished from "rugæ," when occupying a position on the exterior surface of the corallum equal to the interseptal spaces.

The tubular roots, or radiciform processes, are prolongations of the body structure proper and not merely epithecal outgrowths (Pl. IV, Figs. 1, 5). They are hollow, of variable length, but one has been observed as much as one and a half inches long. As a rule, however, they become broken short off, and leave brief wart-like bases to represent the point of outgrowth. Their walls (Pl. IV, Fig. 5) present the same semi-opaque laminated appearance as the body structure of the corallum. This is shown in Pl. IV, Fig. 5 as a very delicate wavy lamination extending from the body substance of the coral into the process. We further learn, from this section, that some at least of these radiciform outgrowths were traversed by diaphragms, two of which are visible, one high up at its junction with the coral proper, and the other near the apex of the process. The latter is one that has clearly not yet attained full development, being rounded and blunt at its termination. The thickest of the objects apparently issuing from the coral is not an anchoring process, but the section of a Crinoid stem. The long tube at right angles to the latter, on the upper left hand of the figure, lying free, illustrates the length to which these processes sometimes attain.

Mucophyllum possesses a wide open centre to the calice (Pl. III, Fig. 2, Pl. IV Figs. 2 and 3), insensibly expanding into the horizontal disc-like portion without the intervention of any thickened rim or line of demarcation. The wall of the calice slopes gently inwards (Pl. IV, Fig. 3), and the floor is practically flat (Pl. III, Fig. 2), and formed by the uppermost tabulum. In the figured specimen, one of our best, this measures one inch in longest diameter, whilst the width of the entire corallum surface, in this instance, is three inches. As I have before said, the "disk" is horizontal and flat, such, for instance, as in Pl. III, Fig. 2; or occasionally it may be gently convex, or the convexity may be restricted to that portion immediately surrounding the calice centre. The turbinate base beneath the calicé floor varies greatly in height, being sufficiently deep in some to accomodate several tabulæ (Pl. IV, Fig. 3), or so restricted as to be represented only by the uppermost tabulum, or at the most two tabulæ, which in the former case practically constitutes the truncated base, and reduces the corallum of *Mucophyllum* to an infundibuliform expansion of stereoplasmic matter.

The septa (Pl. III, Fig. 2, Pl. IV, Figs. 2 and 4) are from seventy-five to eighty in a full grown specimen (*i.e.*, in the only species known), of one order, equidistant and simple, radiating outwards from the bottom of the calice to the circular scalloped periphery, where they correspond to the re-entering angles. These septa manifest themselves on the "disc," not as upstanding lamellæ, but as impressed grooves, and do not impinge on the surface of the central tabulate area

but stop short at its margin; there is, therefore, no twisting or formation of a spurious columella (Pl. III, Fig. 2). In only one instance out of a large number of specimens has any deviation from this been noticed, and in this case a very few septa were seen to pass for a short distance inwards and then disappear in the substance of the floor. In thin sections (Pl. IV, Fig. 4), they are seen to be exceedingly delicate and minutely fluctuating lines, and only in a single instance has any trace of secondary thickening been observed, and then to a very slight extent. In this particular case they are split along the centre as if separating into two laminæ. In one septum that has remained entire, a very faint dark line is traceable in the centre—the primordial septum—and it appears to be along this that fracture has taken place. On the other hand, other similarly thickened septa in the same thin section do not show this line.

A short but well marked slightly pyriform fossula exists, containing a single septum, possibly the cardinal, and rather longer than the others. The septa must be regarded as primordial, for not the slightest trace of a secondary thickening has been noticed in any of them, with the exception mentioned above.

Simple transverse dissepiments have been observed in the lower portion of the corallum only (Pl. III, Fig. 1), around the base, but in no single instance have they been seen extending outwards and upwards. They are simple transverse bars dividing the interseptal loculi hereabouts into rectangular spaces.

On the exterior of the corallum the interseptal spaces are somewhat angular around the corallum periphery, but become flatter, and ultimately concave, as the edge of the disk is receded from (Pl. IV, Fig. 3).

The tabulæ are never numerous, usually straight and generally delicate, and with the exception of the uppermost one forming the floor of the calice are either complete or incomplete. There are only three and six respectively in our most tabulate specimens. In the best vertical section I have succeeded in obtaining, the tabulæ are thickened, becoming of the same solid homogeneous nature as the substance of the corallum, and not apparently thickened by a deposition of secondary matter; in fact they seem to be one with the former, although there is no subdivision of this stereoplasmic mass into layers corresponding with the tabulæ, as if the latter represented successive polyp-cups after Edward and Haime's conception of *Ptychophyllum*.

There seem to be hardly recognisable traces of a proper wall, all that is seen in sections is a very delicate thin peripheral line. This can scarcely be looked upon as a theca, for it does not seem to be the result of the commingling of the proximal ends of the septa. It also follows the outline of the radiciform projections.

The tissue forming the entire corallum is composed for the most part of a homogeneous semi-opaque calcite. It fills the whole of the interseptal spaces or loculi, and does not appear to be broken up into a vesicular structure until quite at

the base of the corallum. In vertical sections taken at right angles to the course of the septa, the latter can be traced in their primordial condition without any trace of a secondary thickening, and a similar state of things is exhibited by thin sections parallel to the plane of the disk. The only formation visible is a secondary dendritic crystallisation of a slightly darker colour than the general mass of the tissue. This crystallisation follows the line of each septum, and in a vertical section parallel to the septa appears as a delicate arborescent branching, not unlike the dendritic manganese of landscape marble. In the sections formerly referred to, taken at right angles to the septa, it is not so apparent; but in those taken in the plane of the disk, or horizontal to the growth of the corallum (Pl. IV, Fig. 4), the interseptal spaces are filled with innumerable dots or specks of a dark colour, and small tufts, probably the cut edges of the arborescent branching. Until this feature is thoroughly grasped, this crystallisation leads to the idea that one is dealing with veritable structure.

III.—Cognate Genera.

1. CHONOPHYLLUM.—Edwards and Haime (Brit. Foss. Corals, Pt. 1, Introd., 1850, p. lxix). The characteristic form of this genus is conical, turbinate, or patellate, varying to cono-cylindrical. The successive peripheries, or outer calicular margins, become horizontally expanded, and often reflexed, but there are no radiciform or root-like processes.* There is no true wall, but a simple protective epithecal covering. The calice is either shallow and basin-like, or deep, and the floor is flat. The primary septa near the centre of the calice are thin and lamellar, but gradually thicken towards the periphery of each polyp-cup, and form convex broad bands of complex structure, each septum consisting of a series of upwardly convex superimposed delicate layers, with granular or spinulose processes developed on the upper surface, to aid in the support of each septum. It was the peculiar but misunderstood structure of these lamellar septa that originally gave rise, says Mr. Sherzer, to the description of complete tabulæ, and superimposed and invaginated separate cell-cups. There is no true columella, but the principal septa extending to the calice centre, become more or less twisted. Neither are there any true tabulæ, nor yet a fossula, but the centre of the corallum below the calice is occupied by irregular transverse "leaflets" representing the tabulæ. Dissepiments were developed in the outer narrow interseptal loculi, becoming fewer and more open towards the calice. In *Chonophyllum*, the position of the interseptal loculi is outwardly marked by the narrow longitudinal grooves on the thin epithecal covering.

2. OMPHYMA.—Rafinesque and Clifford (Ann. Sci. Phys. Bruxelles, 1820, V., p. 235). In this genus the form of the corallum resembles the last, with a similar protective epitheca, and no true wall, deposited in "fine encircling bands or

* Sherzer, Bull. Geol. Soc. America, 1892, III, p. 258.

ridges," the strong radiciform processes being direct continuations of the body substance, as in *Mucophyllum*. In *Omphyma* the corallum is made up of superimposed "cell-cups," represented in the infra-calicinal portion by horizontal tabulæ. The septa, unlike those of *Chonophyllum*, are formed by infoldings of the cell-cups, or extended tabulæ, and forming sharply crested, or angular lamellæ, without subsidiary supporting growths, which terminate at the calice margins, and rarely impinge on the central tabulate area. In consequence of this, there is not even a spurious columella. Four fossulæ are usually present, but one is often more distinct than the others. Sherzer states that the septa and interseptal loculi are not clearly differentiated from one another as in *Chonophyllum*, and the Rugosa in general, but the position of the latter is externally defined by broad longitudinal bands.

Omphyma may, therefore, according to Sherzer, be distinguished from *Chonophyllum*, by the following points:—1. Presence of strong radiciform processes. 2. Presence of broad, well-developed tabulæ. 3. Infolding of the cell-cups to form sharply crested or angular septa. 4. Absence of supporting processes. 5. Coarse, subvesicular structure of the interseptal cavities. 6. Generally broad, smooth, central tabulate area. 7. Presence of one or more fossulæ. 8. The broad costal bands representing the interseptal cavities.

3. PTYCHOPHYLLUM.—Edwards and Haime (Mon. Brit. Foss. Corals, Pt. 1, Introd., 1850, p. lxix). From the writings of those who have studied *Ptychophyllum*, Messrs. Edwards and Haime, Roemer, Dybowski, Sherzer, and others, it appears that the corallum is generally similar in appearance to the two preceding genera, and, like *Omphyma*, possesses anchoring protuberances, whilst the margins of the cell-cups are strongly reflected. The formation of the latter, and the radial infoldings of the septa are similar to the structure of *Omphyma*, but as in *Chonophyllum*, the septa extend to the centre of the tabulate area and are there twisted, forming a false columella, and an elevation on the floor, but the septa are not supplied with spicular, or other supplementary appendages. The epithecal covering is strong and persistent, and the broad bands externally developed correspond to the interseptal loculi. The central area is usually strongly tabulate, and the dissepimental vesicles are coarse, as in *Omphyma*. There is a single fossula, and the position of the septa externally is indicated by the fine longitudinal grooves visible on the epitheca. Edwards and Haime believed that the twisting of the septa distinguished this genus from *Chonophyllum*, but Sherzer has shown* that an equal amount of intermingling takes place in the latter.

According to the last-named authority, *Ptychophyllum* is distinguished in detail from *Chonophyllum* by the following characters:— 1. The more persistent epitheca, and occasional radiciform processes. 2. Well-developed tabulæ throughout the central area. 3. Cell-cups forming sharp or angular septa by their radial infoldings.

* Bull. Soc. Geol. Soc. America, 1892, III, p. 279.

4. Absence of supporting growths. 5. False columella. 6. Coarse subvesicular structure of the interseptal loculi. 7. Generally distinct fossula. 8. Longitudinal bands upon the epitheca, corresponding to the interseptal loculi.

Ptychophyllum may be essentially distinguished from *Omphyma*:—1. By the formation of a false columella. 2. Absence of a clear central tabulate area. 3. One fossula, instead of generally four. It, therefore, follows that *Ptychophyllum* is more nearly related to *Omphyma* than it is to *Chonophyllum*.

IV.—The Relations of MUCOPHYLLUM.

We may now enter on the relations of *Mucophyllum* to the three genera just discussed. It resembles all three in the invaginated reflex-margined corallum, which represents one of their "cell-cups;" but so far as my researches have extended there is no repetition of these "cell-cups," nor are there any external accretion ridges as in *Omphyma*. The structure appears to be absolutely homogeneous, and the body of the corallum does not seem to be made up of successive tabular out-growths. The septa are wholly linear-lamellar, without either the complex structure of *Chonophyllum*, or the outwardly angular form of *Ptychophyllum* and *Omphyma*, and I have quite failed to detect any radial infoldings. There is no vesicular tissue in the outer portions of the interseptal loculi, but the whole is filled with a dense structural homogenity. On the contrary, the only dissipiments visible are around the turbinate base in *Mucophyllum*. A thin epithecal covering is present, as in *Omphyma* and *Ptychophyllum*, and the broad external longitudinal bands represent the interseptal loculi, and are therefore practically analogous to the costæ of other Rugose corals. Anchoring processes are unquestionably present, as in both *Ptychophyllum* and *Omphyma;* and, similar to the former, and probably also the latter, these are out-growths of the body substance, and not merely thecal or epithecal developments.

The septa stop short at the central tabulate area, and there is no trace of a spurious columella. Herein, therefore, our proposed new genus is likened to *Omphyma*, and differs from the other two. The tabulæ in the central infracalicular area are well developed, although at times incomplete, again a departure from *Chonophyllum*, and I have quite failed to detect any prolongation of them between the septa to assist in forming an interseptal vesicular structure. One fossula only is present, thus allying our coral to *Ptychophyllum*, and separating it from both *Chonophyllum*, in which there is said by Sherzer to be none, and from *Omphyma* with its four fossulæ as a general rule. The presence of the cardinal septum in the fossula is a decided feature of the Zaphrentidæ.

In conclusion *Mucophyllum* may be said to be, in general terms, an *Omphyma* of one cell-cup possessing linear septa and a single fossula; or a *Ptychophyllum* of one cell-cup, without a spurious columella, and with no projection on the central tabulate area.

V.—Generic and Specific Characters.

MUCOPHYLLUM*—*Gen. nov.*

Gen. Char. — Corallum simple, of one cell-cup, large, patelloid, somewhat turbinate below, with root-like radiciform processes, which are prolongations of the body substance, and not developed from an epitheca or theca. Calice basin-like, with strongly reflected margins, no proper wall visible, but a thin epithecal covering; costæ present. Septa simple, numerous, not formed by lamellar infoldings. Interseptal loculi free, simple, dissepiments only in the lower portions, around the truncate base. Spurious columella absent. Fossula single, large, containing one or more cardinal septa. Tabulæ complete or incomplete, well developed, and sometimes thickened; intertabular loculi narrow, subvesicular at times.

MUCOPHYLLUM CRATEROIDES—*Sp. nov.*

Pls. III. and IV.

Sp. Char.—General characters as in the genus. Corallum attached, attaining as much as four and a half inches in diameter, and one and a quarter inches in height, edge of the calicular disk scalloped; radiciform processes irregularly scattered, attaining one and a quarter inches in length. Calice moderately deep, sides gradually curving outwards, the distal portions forming a more or less horizontal expansion. Septa from seventy-five to eighty, thin, delicate, fluctuating, very rarely thickened, and then only slightly so; fossula short, containing one septum, the cardinal. Central tabulate area wide.

Obs. Mucophyllum crateroides in a very characteristic fossil at certain horizons in rocks at present assumed to be Upper Silurian. I believe it to be the *Ptychophyllum patellatum* mentioned by the late Professor de Koninck, an assumption grounded on the fact that his description of the supposed Australian fossil is nothing more than a slightly free rendering in French of Edwards and Haime's diagnosis † of the British form of that species. At any rate, a *Ptychophyllum* pure and simple, has not yet come under my observation from any Australian locality.

Loc. and Horizon.—Hatton's Corner, Yass River, near Yass (*T. W. E. David, &c.*); Hume or Bowning Series. Old Lime-kiln Ridge, Humewood, near Yass (*W. S. Leigh and R. Etheridge, Junr.*); Hume or Bowning Series. Quedong, Delegate River, Co. Wellesley (*C. Cullen*)—Upper Silurian.

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* ὁ μύκης, a mushroom.
† Mon. Brit. Foss. Corals, 1854, Pt. 5, p. 291.

IV.—Mineralogical and Petrological Notes, No. 2: by George W. Card, A.R.S.M., F.G.S., Curator and Mineralogist.

I.—Contents.

II.—Mineralogical Notes.

1. *Eisenkiesel from Fairfield, Drake, New England.*—Deep-red in colour, and spotted with numerous opaque-white globular patches. These patches vary in diameter up to a millimetre; they are somewhat aggregated together and sometimes single, and a cavity often occurs in the centre. Sometimes the white material merely constitutes a rim to a nucleus of brown. In addition to these spots there are a number of irregular cracks and cavities lined with colourless crystalline quartz. The stone takes a good polish, presenting a handsome appearance closely resembling jasper.

Under the microscope [Slide 440] it is found to consist entirely of crystalline quartz; the individuals being of considerable size, and intergrown with one another. Scattered through the mass is a red dust to which the colour of the rock is due. The outlines of earlier crystals, marked by lines of impurities, may sometimes be detected. The silica surrounding such crystals polarises in an irregular manner, suggesting that it may once have existed in chalcedonic form. The white markings are found to consist of aggregations of particles of quartz, which give rise to very irregular polarisation effects.

By reflected light a pattern, traced by opaque-white bands in a manner comparable to the "fortification" structure noticeable in certain agates, is brought out. The outlines of earlier crystals, just referred to, work into these patterns. Within the area marked off by the pattern a number of rings, also bounded by white bands, are sometimes present.

Under favourable conditions of working it is possible that something might be done with this rock should it be found to exist in any quantity.

2. *Covellite from Broken Hill.*—From the Consols Mine, per Mr. G. Smith. Earthy in texture, and of an indigo-blue colour. Intimately associated with massive and crystalline cerussite. It is traversed by veins of cerussite to such an extent as to render it almost impossible to get a pure specimen of the copper mineral. The latter gives off sulphur readily on heating, and is very fusible. Copper reactions are readily obtained.

3. *Epidote-rock containing metallic copper from Emmaville.*—A very hard compact rock, of the usual yellowish-green colour, with small specks of native copper scattered through it. Examined with the microscope (Slide 441) it is found to consist principally of colourless and pale yellowish-green epidote, the spaces between the crystals being filled with quartz, which is sometimes traversed by bundles of colourless acicular crystals radiating from the edges of the epidote. Broken and cleavage-fragments of epidote are included in the quartz. A number of crystals of a purplish colour, and probably augite, also occur. An assay (1372/93) gave traces of gold and silver.

4. *Mimetite from Broken Hill.*—An old specimen labelled "Central Mine." The mimetite occurs with chloro-bromide of silver on ironstone and ferruginous kaolin. The crystals have the usual prismatic habit, and sometimes attain a length of three millimetres. Colour, brown.

5. *Turquoise from Wagonga*—Presented by Mr. C. L. Garland. Pale-blue in colour, occurring in veins of about 3·5 millimetres in width. This is believed to be the first recorded occurrence in New South Wales.

6. *Mispickel in Volcanic Tuff from Windeyer and Tambaroora.*—Collected by Mr. T. W. Atherton. At the Jubilee Mine, Windeyer, the mispickel occurs in nodules presenting a plumose structure when broken across. By comparing a number of specimens the nodules are found to be in reality large crystals built up of curved fibres. In a similar rock from Tambaroora, the mineral occurs in large plate-like crystals.

7. *Diamond from Euriowie.*—Presented by Mr. Paulson, and believed to come from Euriowie. Length, five millimetres. The crystal consists of the hexakis-tetrahedron. It is straw coloured, and somewhat chipped and flawed. Specific gravity, 3·64.

8. *Copper-Uranite (Torbernite) from Carcoar.*—Collected by Mr. T. W. Atherton from the Carcoar Cobalt Mines. It is found adhering to an igneous rock in the form of groups of square plates. These plates are very uniform in size, averaging about a millimetre in length of side. In colour it is emerald-green,

in lustre pearly, and very micaceous in appearance. The quantity available was very small, so that a satisfactory examination could not be made. The following results have been obtained:—

A yellow precipitate on adding ammonic-molybdate to the nitric acid solution.

An occasional copper-green colouration to the blow-pipe flame.

A green microcosmic-salt bead in O.F. and R.F., the colour being perhaps somewhat darker in O.F.

Water doubtful.

A small flake, examined between crossed nicols, gave straight extinctions. No satisfactory interference-figure could be obtained. The occurrence of this mineral in New South Wales has not been previously recorded.

V.—Willyamite—a New Mineral from Broken Hill: by E. F. PITTMAN, A.R.S.M., Government Geologist.

TOWARDS the latter end of last year Mr. George Smith, at that time Assistant Manager, now General Manager of the Australian Broken Hill Consols Mine, discovered what he judged to be a new mineral, associated with dyscrasite in a gangue of calcite and siderite, at a depth of one hundred and fifty feet (vertical) in that mine. He forwarded a specimen of it to me, and stated that he had found it to contain antimony, sulphur, and cobalt. At my request complete duplicate analyses were made of the mineral by Mr. J. C. H. Mingaye, F.C.S., Analyst and Assayer to the Department, who found its composition to be as follows:—

	No. 1.	No. 2.
Sb	56·85	56·71
Co	13·92	13 84
Ni	13·38	13·44
Fe	trace.	trace.
Cu	minute trace.	minute trace.
Pb	miuute trace.	minute trace.
S	15·64	15·92
	99·79	99·91

The formula, which corresponds almost exactly with these analyses, is $Co\ S_2$ $Co\ Sb_2$; $Ni\ S_2$, $Ni\ Sb_2$, the mineral being a sulph-antimonide of nickel and cobalt. A sulph-antimonide of nickel (ulmannite) is already known, and in Dana's "System of Mineralogy," one specimen of it is mentioned as containing

1·06 per cent. of cobalt. Ulmannite has been found in South Australia, but never, so far as I am aware, in this Colony. The presence, however, of such a large and apparently constant percentage of cobalt in the Broken Hill mineral seems to justify its recognition as a new species, and I have accordingly given it the name of Willyamite (pronounced Willy-ah'-mite), after Willyama, which is the official name of the Broken Hill township, and which, in the language of the Aborigines, means "a hill with a broken outline."

The following are the physical and pyrognostic characters of Willyamite:—*System of crystallisation*—Isometric. *Cleavage*—Cubic, perfect. *Fracture*—Uneven, brittle. *Hardness*—About 5·5 *Specific gravity* (mean of a number of experiments) —6 87. *Lustre*—Metallic. *Colour*—Between tin-white and steel grey. *Streak*—Greyish-black. In the closed tube, and next to the assay, yields a dark red sublimate, which is orange-coloured in cooling, and this is surmounted by a faint white sublimate. In the open tube decrepitates, yields antimonial and sulphurous fumes; near the assay the white sublimate shows in fern-like forms. Before the blowpipe on charcoal fuses readily to a globule, which boils and emits sulphurous and antimonial fumes. With borax glass gives at first the cobalt-blue colour, but after oxidising all the cobalt the nickel reaction is obtained. Decomposed by nitric acid with separation of antimony trioxide.

VI.—On a Vertebra from the Wellington Caves: by W. S. DUN, Assistant Palæontologist and Librarian.

[Plate V.]

I.—*Introduction.*

THE specimen about to be described was found by Mr. James Sibbald, Keeper of the Wellington Caves, in the calcareo-ferruginous cave breccia of No. 4 Cave, in 1892, together with a large number of remains of extinct marsupials. The specimen is so well preserved that it was thought that a short description and figure of it would be of use for purposes of comparison. The vertebra is clearly one of the cervical region, and its great size separates it from any known extinct marsupial, except *Diprotodon*, *Nototherium*,* *Euowenia*, *Phascolonus*, and *Palorchestes*. From the form, which is described later on, it will be seen that

* I include under this generic name *Zygomaturus*, which is considered by Mr. De Vis, and was likewise by the late Gerard Krefft, to be separate from *Nototherium* in opposition to the opinion of the late Sir R Owen. For a discussion of this subject, *see* R. Lydekker, *Ann. Mag. Nat. Hist.*, 1889, iii (6), pp. 149–152

the reference of it to *Phascolonus* or *Palorchestes*, members of the families Phascolomyidæ and Macropodidæ respectively, is out of the question, and the only known genera to which it can belong are *Diprotodon*, *Nototherium*, and *Euowenia*. At present *Euowenia* is known from remains of the jaw only, so that the relations of the bone in question to the latter cannot be entered into at the present time. Remains of *Diprotodon* are fairly common in the Wellington Caves, indeed it was there that Sir Thomas Mitchell obtained the specimens on which the genus was founded.* Remains of *Nototherium* do not seem to have been so common, no specimens having as yet been described from these caves. The late Mr. C. S. Wilkinson mentions *Nototherium Mitchelli*, *N. Victoriæ*, and *N. Krefftii* as occurring there,† but I am not acquainted with the source of his information. The late Mr. Gerard Krefft, Curator of the Australian Museum, in his report on the specimens of vertebrate remains collected under the supervision of the late Professor Thompson and himself in 1869,‡ gives the following items under the head of *Zygomaturus*—part of a second upper molar, and a right upper premolar—and adds, "There is in the Museum collection a splendid series of fossil remains, indicating at least two new species of the above genus, but as the list comprises Wellington specimens only, they are not enumerated here."§ He makes no mention of *Nototherium* (in the restricted sense) in this report as occurring at Wellington. As far as the vertebræ of *Nototherium* are concerned I am only acquainted with Sir Richard Owen's description of the atlas, so that the only vertebra with which it can be absolutely compared is that of *Diprotodon australis*; and, as will be shown later on the evidence seems to be sufficiently strong to refer it to *Diprotodon*.

II.—Description.

The vertebra is well preserved, portion of the neural spine and parts of the transverse processes being the only portions destroyed. Sufficient of the neural spine is preserved to show that it was directed backwards with a slight curve, and is slightly compressed in a lateral direction. The articular surface of the anterior zygapophysis is not so elongated as in *Macropus*, and is perfectly flat, and not slightly curved as in that genus; it is only very slightly inclined from behind forwards, not to a great degree as in *Phascolarctos*. The posterior zygapophysis is somewhat larger than the anterior; the inner border is slightly raised and continues to the base of the diapophysis. The surface of the posterior zygapophysis is slightly lower than that of the anterior and does not slope inwards to such an extent. The lower portion of the neural arch—the neurapophysis of Owen—gives rise to a fairly thin but well-developed diapophysis, which, together with a strong parapophysis, enclose the very well developed vertebraterial canal, and join to form the transverse

* Three Expeditions into the Interior of Eastern Australia, &c., II, pp. 362-363, t. 31, f. 1 and 2. (8vo. London, 1838).
† Min. Prod. N. S. Wales, 2nd Ed., 1887, p. 90.
‡ Exploration of the Caves and Rivers of N. S. Wales (Minutes, Reports, &c.) N. S. Wales rl. Papers, 132—A. 1882, pp. 8-13. (Folio, Sydney. By Authority).
§ *Loc. cit.* p. 9.

process, the remains of which show it to have been directed posteriorly. The centrum is ellipsoidal in shape and slightly bi-concave, and in its shortness seems to be far removed from the Macropodidæ, and to approach more nearly to the Phascolomyidæ. There is a well-marked venous opening on the upper surface of the centrum. The anterior aspect of the neural arch shows considerable roughening at the base of the neural spine, and there is a well-marked hollow immediately over the hinder border of the anterior zygapophysis. There is no sharply-marked ridge along the aspect of the neural spine. Viewed posteriorly, one point that is very noticeable is the well-marked groove between the centrum and the base of the neurapophysis, and which was pointed out by Sir Richard Owen as being so well developed in *Diprotodon australis**—the "conjugational foramina"; this is present though less marked on the anterior side. On the median line between the two posterior zygapophyses is a well-marked ridge arising from the ledge that forms the posterior of the summit of the neural canal. This ridge is only faintly continued along the neural spine. The sides of the neural arch slope forward. Just in front of the right posterior zygapophysis, on the inward slope of the neural arch, is a well-marked depression which does not occur on the other side. The vertebra gives the following measurements in millimetres :—

Centrum, length	34
„ depth, anterior face...	54
„ width	70
Neural canal, height	25·5
„ width	50
Vertebraterial canal, width	16
„ depth	13
Neural arch, thickness	28
Neural spine, thickness at 28 mm. from neural canal	22
„ „ antero-posterior	26·5
Posterior zygapophysis, length	35·5
„ „ breadth	30·5
Anterior „ length	31·5
„ „ breadth	29·5

On the whole the general characteristics of the vertebra lead to the conclusion that it belongs to *Diprotodon*, most propably *D. australis*, Owen. Nothing as yet is known of the vertebræ of *Diprotodon minor*, Huxley,† or *D. longiceps*. M'Coy,‡ the jaws alone of these two species being known. A comparison of the figures of this specimen with those given by Sir Richard Owen of the third cervical vertebra of *Diprotodon australis*§ will show great agreement in every respect except that

* Phil. Trans., 1870, p. 542.
† Quart. Journ. Geol. Soc., 1862, XVIII, pp. 422–427.
‡ Prod. Pal. Vict., 1876, Dec. 4, pp. 7–11.
§ Phil. Trans., 1870, t. xliv, fig. 4; Foss. Mam. Austr., 1877, t. 29, fig. 4.

of size, which is most probably due to difference of age or of sex of the individuals to which they belonged. The description and woodcut also given* agree with that of our specimen, with very slight exception, for instance in the slight lateral compression of the neural spine, which does not prevail in the type specimen. The form and inclination of the neural spine and the general form of the vertebra as seen in a side view show it to be more like the third cervical as figured in the above-mentioned woodcut than either the fourth, fifth, or sixth, so that it seems safe to refer to that position in *Diprotodon*, leaving the specific determination in abeyance.

VII.—On the Occurrence of an Auriferous Raised-beach at the Evans River, Co. Richmond, N. S. Wales: by G. A. STONIER, F.G.S., Geological Surveyor.

THE Evans River, known locally as the Little River, is in the north-eastern portion of N. S. Wales, and rises behind the township of Woodburn, Parish of Riley, Co. of Richmond, flowing to the east into the Pacific Ocean. On its northern bank there is a wide, somewhat fan-shaped, flat which extends to the Richmond River and is formed partly of freshwater alluvium (the rich agricultural soil of the district), and partly covered by blown sand. To the south-west there is an extensive development of sandstones and shales of the Clarence Coal-measures, considered to be of Triassic age; at the mouth of the river the sandstones, &c., with a boss of felsite, form a large headland, but coming south along the coast the rock is lost under a covering of blown sand which occupies, at a distance of three miles from the river, an area somewhat lozenge-shaped, and measuring nearly three miles in its greatest breadth and seven miles in length, as far as examined. The sand is arranged in lines of dunes, one of which reaches one hundred and thirty feet in height and forms a range of hills a couple of miles in length; others are in the form of ridges and eminences separated by swampy flats. The area is bounded on the west by sandstones of the Coal-measures and on the east by the ocean beach, while at Bullock Creek, about the centre of the formation, a small inlier of slate of Lower Carboniferous (?) age makes its appearance.

Gold has been obtained along the coast for many years from Port Macquarie to the Queensland Border, and at the Evans River is now being obtained from (1) present sea-beach, (2) a slightly raised sea-beach, (3) "back terrace" (probably a raised sea-beach). The first named consists only of the streaks of black sand

* Phil. Trans., 1870, p. 542, fig. 5; Foss. Mam. Austr., 1877, p. 212, fig. 5.

which are usually worked by beach-fossikers. No. (2) occurs immediately at the back of the beach, which is narrow and inclined and often covered by surf; the deposit, which has been worked in patches for about two miles, is covered by drift-sand varying in thickness from three to sixteen feet. As none of the claims were working the pay-dirt, there was no opportunity for measuring its thickness; some patches have been very rich—one small claim yielded one thousand ounces of gold—and although there are several months of work practically in sight for two or three claims, the bulk of the gold has been won.

The "back terrace" (3) has been recently found, and the discovery has opened up new possibilities for mining in the district. The deposit, which consists of black sand and is probably an old sea-beach, is situated a quarter of a mile inland from the coast, and is about six feet above ordinary high-water mark. It has been traced for some four miles in length, and, though doubtless continuous at one time, it has been denuded and now occurs as outliers, covered by blown sand up to twenty-feet in thickness. Four of these patches have been discovered, and one of them has been proved to be a couple of hundred yards in length, but the others require to be further tested before their length can be measured. The black sand varies from one to five feet in thickness with a decided dip seawards, and is generally thickest in the centre, slightly tapering off at the sides. Under the microscope it is seen to consist of minute grains of quartz and a little topaz with fine specks and pellets of ilmenite (titanic iron), gold, tin, platinum, osmium, iridium (possibly other platinoid metals), a little magnetite, limonite, and small garnets (?); occasionally a few flat sandstone pebbles occur, the largest usually found measuring one foot by eight inches by two inches; the colour of the sand varies from whitish-grey to black. The quartz grains are opaque and white with a large sprinkling of pieces of rock crystal; a few show traces of crystalline facets, but most of them are well-rounded, some resembling in shape the pencil-tourmaline common in the New South Wales diamond-drift. As a rule the black sand rests upon and at the sides passes imperceptibly into a white sand, which consists chiefly of fine and well rounded quartz grains, and overlies a consolidated, in places quite hard, peaty sand representing probably an old land surface, as do many similar sections in the æolian deposits about Sydney. No attempt has been made to prove the formation below this hard sand-rock.

The gold, which is exceptionally pure, and brings £4 2s. 3d. per ounce, is very fine, and appears to be free from "rust"; most of the specks are somewhat shotty, but there is also a certain proportion of float-gold.

The platinum is of steel-grey colour, and occurs as minute flat specks with a metallic lustre, and of a more or less longitudinal section, occasionally turned up at the edges. Osmium, iridium, and probably other platinoid metals are found, but in varying proportions. Tin has been found in minute grains and of small percentage.

The method adopted for saving gold has hitherto been of the simplest kind, but there is a likelihood that an attempt will be made to concentrate and separate all the marketable minerals. The claims are worked only for gold, and those which are favourably situated are returning more than wages; other claims have failed to pay, partly because the gold is somewhat patchy and partly on account of the expense entailed when the stripping, some twenty-five feet, has to be raised to the surface, and the construction of a tail race is impossible.

The three deposits to which reference has been made are the only ones that have been yet discovered, but there is much speculation as to the existence of other beaches, and with the evidence all along the coasts of New South Wales and Queensland of elevation at various times, it is but fair to conclude that there may be further traces of old beaches; the evidence of subsidence is not so conclusive, but the formation cannot be considered to have been proved until the bed-rock has been touched at carefully selected sites. Owing to the quantity of water which may be met with, and the thickness, some forty feet in places, of loose sand to be sunk through, it will not be an easy matter to put down shafts to the bed-rock; the work would be more easily performed with a sludger.

The difference in value between the beach and terrace gold is interesting; the former brings £3 16s. 0d. and the latter up to £4 2s. 3d. per ounce, so that it is likely that there are two sources from which the gold has been derived. The late C. S. Wilkinson* states that at Ballina the gold and platinum have been derived from the denudation of a sheet of basalt, which has been proved by bulk crushings to be auriferous. At the Evans River some of the gold may have come from basalt, although the Ballina sheet does not appear to extend so far south; another source may readily be found in quartz veins traversing slates, which make only a small outcrop on the field, but are largely developed in parts of adjoining districts.

A further reference will be published in the "Annual Report of the Department of Mines and Agriculture for 1894."

* Ann. Report Dept. Mines N. S. Wales for 1889 [1890], p. 203.

VIII.—On the Occurrence of a *Pteronites (P. Pittmani*, sp. nov.) in the Spirifer Sandstone of Warrawang, or Mount Lambie, near Rydal: by R. ETHERIDGE, Junr., Palæontologist and Librarian.

[Plate VI.]

I.—Introduction.

THE comparatively meagre fauna hitherto found associated with the Mount Lambie Spirifer Sandstone renders any augmentation valuable, more particularly when the addition is in comparatively large numbers. The only Mollusca so far published from this horizon are *Spirifera disjuncta*, *Rhynchonella pleurodon*,* and "*Pecten*, *Orthis*, *Murchisonia*, *Modiola*,"† the two first named being very common and characteristic. I now desire to place on record the occurrence of a well marked shell, resembling in some respects the genus *Aviculopinna*, Meek, but more especially *Pteronites*, McCoy. This, it is proposed to name *Pteronites Pittmani*, in honour of the Government Geologist, who, in company with Professor T. W. E. David, collected the specimens.

II.—General Description.

The fossils occur as casts of the exterior, not impressions in the strict sense of the word. The shell is transversely elongated, pinnaform, sub-compressed, with a straight hinge line, or cardinal margin, extending the entire length of the shell. The ventral edge is obliquely sloped from the anterior end downwards, and insensibly passes upwards into the posterior edge, which in its upper course becomes slightly emarginate. The bodies of the valves are most convex—but not greatly so over any portion of their surface—in a line drawn immediately from the umbones towards what would be the posterior ventral angles, but the convexity is confined to the anterior thirds of these lines. The cardinal margin in each valve is quite straight, and at its outer termination forms at the junction with the posterior edge an acute point. The anterior end is small, but very well defined, lobe-like, and acutely pointed; the posterior end in each valve becomes flattened. The umbones, as distinguished from the beaks,‡ are convex, and raised slightly above the level of the cardinal margin. The sculpture consists of numerous concentric laminæ, becoming emarginate on the posterior end, following the outline of its edge. They become coarser towards the ventral margin, and there are always a few very well-marked along its whole length. There are no radiating costæ.

No traces of internal structure are apparent, except on two specimens. On one, a slight and delicate thickening along the cardinal margin is apparent, and on

* De Koninck, Foss. Pal. Nouv.-Galles du Sud, Pt. 2, 1876, pp. 95 and 100.
† C. S. Wilkinson, Geol. Map of the Districts of Hartley, Bowenfels, Wallerawang, and Rydal, 1875, Ref. note 11 (*Dept. Mines, Sydney*, 1875).
‡ I retain the word "beaks" for the immediate apices of the umbones

another, what may be a cast of the posterior muscular impression, as a small circular eminence on that region of the posterior end, where this scar should occur. I have not succeeded in establishing the presence of a byssal sinus.

III—Generic Affinity.

Three genera are open to discussion in this respect, *Pteronites*, *Aviculopinna*, and *Palæopinna*. It entirely agrees with M'Coy's definition of *Pteronites*,* except in the rather more pronounced anterior end, and absence of a byssal sinus. With *Aviculopinna* it accords perfectly in outline, closely resembling the little American *A. americana*, Meek,† but is unlike the German *A. pinnæformis*, Geinitz, sp.,‡ which does not possess an emarginate posterior end, but exhibits radiating costæ. On the other hand, in outline it is equally akin to *Pteronites angustatus*, M'Coy,§ of the Irish Carboniferous Limestone, but the latter is a much more slender shell, has a smaller anterior end, and no posterior emargination. *Pteronites latus*, M'Coy, may also be cited as a somewhat similar shell. The truncate anterior end in Hall's *Palæopinna*, such as *P. flabella*,** of the Chemung Group, at once separates our fossil from that genus. But of all the forms with which I am acquainted, *Pteronites profundus*, Hall†† appears to be the nearest ally, even to the small pointed anterior end. *Pteronites Pittmani*, however, is not so deep a shell from the cardinal to the ventral margin, and is proportionately more transversely elongated.

IV.—Specific Diagnosis.

Pteronites Pittmani—*Sp. nov.*

(Plate VI.)

Sp. Char. Shell transversely elongated, pinnaform; cardinal margin straight, extending the whole length of the shell; posterior slope somewhat convex towards the anterior, and shading off into the posterior end. Ventral margin curving obliquely downwards and insensibly passing into the posterior margin, which is shallowly emarginate above. Anterior end small, lobe-like, pointed; posterior end flattened. Umbones convex, raised slightly above the cardinal margin. Apparently no byssal sinus. Posterior muscular impression (?) small, circular. Sculpture of concentric laminæ, parallel to the margin, becoming convex below, but no radiating costæ.

Obs. Named in honour of Mr. E. F. Pittman, A.R.S.M., Government Geologist of New South Wales. The nearest ally is *Pteronites profundus*, Hall, of the Chemung Group of North America (Upper Devonian.)

Hor. and Locality.—Solitary Creek, at Ferngrove, near Warrawang, or Mount Lambie, near Rydal, Co. Cook (*E. F. Pittman* and *T. W. E. David*)—Spirifer Sandstone, Upper Devonian.

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* Synop. Carb. Lime, Foss. Ireland, 1844, p. 81.
† Hayden's Final Report Geol. Survey E. Nebraska, 1872, p. 197, t. 9, f. 12, a-d.
‡ Dyas, Heft, I, 1861, t. 14, f. 1-4.
§ *Loc. cit.*, p. 81.
** Pal. N. York, 1884, V, Pt. I, No. 1, t. 25, f. 18.
†† Pal. N. York, 1884, V. Pt. I, No. 1, t. 32, f. 25-27.

IX.—On Fuller's Earth from Wingen: by GEORGE W. CARD, A.R.S.M., F.G.S., Curator and Mineralogist.

A SAMPLE of unctuous clay from Wingen has been found to possess the characteristics of Fuller's Earth. When received the clay was very wet and soft, but not plastic. It dried very slowly in the air and became friable. The colour may be described as yellowish-green; when moderately heated it becomes colourless, finally fusing to a green glass. The lustre of a cut surface is shining. It does not adhere to the tongue. Under water it softens and falls down, and can then be used with excellent effect for cleansing purposes. The general appearance is somewhat suggestive of some of the material obtained from Bedfordshire, England.

An analysis (2394/93) of an air-dried sample, made by the Assayer and Analyst gave results as follows:—

Moisture	13·73
Combined water	6·45
Silica	50·61
Alumina	19·35
Ferric oxide	3·55
Ferrous oxide	nil.
Manganous oxide	nil.
Lime	1·37
Magnesia	3·24
Potash	·92
Soda	·47
Phosphoric anhydride	trace.
Sulphuric anhydride	nil.
	99·69

Mr. Tom S. Walsh, of Wingen, has kindly supplied the Author with the following particulars as to the mode of occurrence of the deposit. A bed of sandy clay, containing plant-impressions, is succeeded by a very thin (three inches) band of carbonaceous clay, underlying which is the Fuller's Earth. The earth constitutes a bed varying from thirty-two to thirty-six inches in thickness and very nearly horizontal. Another thin band of carbonaceous earth succeeds, and is followed by sandstones. The clay crops out on the bank of a small stream; the sample was taken close to the outcrop.

As this appears to be the first recorded occurrence of Fuller's Earth in New South Wales, a few remarks will be offered on its uses and sources of supply.

The importance of the earth for the cleansing of cloth from grease was at one time so great that its exportation from England was prohibited by Act of Parliament.*

* "The British Legislature, therefore, have, from the days of Charles I., guarded against the exportation of it under severe penalties." Journey from Chester to London by Thomas Pennant, 1811. (Quoted by Mr. A. C. G. Cameron—*Proc. Geol. Assoc.*, XII, p. 309, footnote.)

It is now made use of in a variety of other ways; in the cleansing of many articles; in the preparation of ultramarine; in the manufacture of various toilet and curative articles; and, more particularly, in the clarification of lard, for which purpose a large quantity is exported to America.

The action of Fuller's Earth upon water is of considerable importance. As will be referred to below, the water used in Somersetshire for washing the crude earth is found to be softened and purified. The water thrown out by the beds in Bedfordshire is similarly affected. The villagers throw blocks of it into their wells, and it is stated* that it is also carried to the Fen District to be used as a filter for clarifying the peaty water.

The following table, compiled from the 'Mineral Statistics of the United Kingdom,' gives the quantities raised in England in 1891 and 1892, with the value at the mines:—

	1891.		1892.	
	Tons.	Value.	Tons.	Value.
Bedfordshire	671	£756	3,703	£4,166
Somersetshire	6,004	£7,506	4,965	£4,300
Surrey	4,500	£10,300	755	£750

It will be noted that the price varies from one to two pounds per ton; but the market is said to be controlled by a "ring."

During a recent visit to the Bedfordshire Mines the Author obtained the following information.

The beds of Fuller's Earth occur in the Lower Greensand formation of the Cretaceous Series; they are about ten feet thick and are sinuous in section—nearly horizontal, but not straight. Regular mining operations are carried on, the galleries being extensively timbered. When raised the clay is dried in kilns and pulverised by an American "Cyclone" mill. The beds are alternately yellow and blue in colour.

At Midford, in Somersetshire, the Fuller's Earth occurs in the Fuller's Earth formation of the Jurassic Series, and is from four to seven feet thick. The colour is yellow at the outcrop and blue beneath. It is worked by galleries driven into the hill-side. The process of preparation for the market differs here from that employed in Bedfordshire. "The raw earth . . . . is ground up (in a 'pug-mill') with about three times its own bulk of water. The compound, known as 'slurry' is then turned into a series of little tanks or 'catch-pits,' and while the finer Fuller's Earth remains in suspension the coarser particles sink to the bottom. The liquid, which still contains some impurities, is then allowed to run

* Proc. Geol. Assoc., XII, p. 309.

into a long earthenware drain, laid underground, which conveys it to the works more than half-a-mile distant. Here the turbid water flows into a long shallow trough called a 'maggie,' and the coarser particles still contained in it subside and are caught by a series of little wooden steps placed across the bottom of the trough. By these processes the Fuller's Earth is purified. It is now run into large tanks, and the suspended earth is allowed to settle gradually; while the surface water that is drained off is said to be very soft, pure and drinkable. These operations take about thirty days, and now a damp, clayey mass remains in each tank. This material is removed to a large drying shed, where, by means of a furnace and hot-air flues, it is thoroughly dried, and is then ready for the market."*

At Nutfield, in Surrey, the beds also occur in the Lower Greensand, and are about twelve feet thick. As in Bedfordshire and Somersetshire, the colour is blue and yellow.

A number of analyses of Fuller's Earth have been made, and full details of them for Bedfordshire and Somersetshire will be published shortly in 'Memoirs of the Geological Survey of Great Britain.' These show that the detergent properties of the earth are not dependent upon composition, but must be related to its mechanical condition. The blue and yellow varieties are, speaking generally, equally valuable.

X.—Palæontologia Novæ Cambriæ Meridionalis. — Occasional Descriptions of New South Wales Fossils, No. 1: by R. Etheridge, Junr., Palæontologist and Librarian.

[Plate VII.]

UNDER this title it is intended to give, as opportunity offers, brief notes on fossils found in New South Wales.

1. *Further Traces of* SCHIZONEURA.

Pl. VII, Fig. 1.

The fragmentary plant represented in Pl. VII, Figs. 1 and 2, is regarded as a possible confirmation of the occurrence of *Schizoneura* in our lower rocks of Triassic age. The other possible reference is to *Phyllotheca*, but the balance of evidence seems to be in favour of the former genus. The specimen consists of a transverse section of a circular stem, with portions of two leaves and traces of the base of a third given off in a verticillate manner. Each of the lanceolate leaves is split after the manner of *Schizoneura*, a feature that was not apparent in my figure† of the Bulli specimen. This has, however, been excellently explained by O. Feistmantel in the case of the Indian *S. gondwanensis*. It may be contended that as *Schizoneura* possesses but two leaves

* Proc. Geol. Assoc., XIII., pp. 126-127.
† Records Geol. Survey N. S. Wales, 1893, III, Pt. 3, p. 74.

opposite one another,* and there are traces of three in our example, the latter cannot be well referred to the Indian genus. Yet, on reference to other figures† of Feistmantel's, it will be seen that when the leaves are broken up into their component parts they assume a verticillate appearance, forming a series of strap-shaped segments radiating from the entire periphery of the stem, and thereby assuming the position represented in Pl. VII, Fig. 1. This would be naturally increased if these leaf-portions in *S. gondwanensis* were pressed from above downwards, as in the present case. The chief factor against the reference of this fossil to *Schizoneura* lies in the absence of the distinctly marked wide-apart veins.

Turning now to *Phyllotheca*, we may remark that in *P. australis*, Brong., the leaves are long, linear, and pointed, and it is quite possible that the next form but one is identical with this. In *P. ramosa*, McCoy, the leaves forming the free edges of the sheaths are very numerous, fine, and short‡; whilst in *P. Hookeri*, McCoy, they are, although equally plentiful, long and proportionately fine and narrow§. Moreover in all these species, each leaf is provided with a central mid-vein. This delicacy of the leaves seems to be an almost universal feature of *Phyllotheca*. Without, therefore, insisting on the identity of our plant fragment with *Schizoneura*, I think it well to regard it as such for the present, and in some degree confirmatory of my former determination.

The specimen is of more than ordinary interest from its occurrence at a much higher horizon in the unproductive beds between the uppermost coal seam of the Upper Coal Measures and the Hawkesbury Sandstone in the Second Cremorne Bore, Shell Cove, Port Jackson, at a depth of one thousand two hundred and seventy-four feet six inches. In other words, in a portion of the olive-green shales of the Narrabeen Series. Collected by Mr. E. F. Pittman, A.R.S.M.

Sir F. McCoy has called my attention to an oversight in my remarks on *Schizoneura australis* in connection with determinations of his own, for which I express regret. In his 'Report on the Palæontology of the Geological Survey [of Victoria] for the year 1891,' he mentions his recognition of Lower Triassic rocks of Bunter Sandstone age, at Bacchus Marsh, in the following words:—"For this determination I have only a few fragmentary examples filled with comminuted plant remains from a newly discovered bed, just under the famous *Gangamopteris* sandstone of Bacchus Marsh. . . . One of the plant fragments seems clearly to indicate a *Schizoneura*, and if this determination be borne out by additional specimens, which should be procured, the indication will be the addition to the Geological Map of Victoria of the Lower Trias formation, or Bunter Sandstein," &c.|| It will be observed that the specimens are spoken of as comminuted.

* Pal. Indica (Gondwana Flora), 1880, III, No. 2, Pt. 1, t. 4a.
† *Ibid*, t. 7a, f. 2, &c.
‡ Ann. Mag. Nat. Hist., 1847, XX, t. 11, f. 2.
§ Ann. Mag. Nat. Hist., 1847, XX, t. 11, f. 4, 5.
|| Ann. Report Secy. for Mines Vict. for 1891 [1892], p. 30.

2. SAGENOPTERIS (?) *in the Narrabeen Series.*

Sagenopteris salisburoides, Johnston ?

Pl. VII, Figs. 2 and 3.

Sagenopteris salisburoides, Johnston, Proc. R. Soc. Tas. for 1886 [1887], p. 170.
„ Johnston, Syst. Acc. Geol. Tas., 1888, t. 28, f. 4 and 4a.
Sagenopteris (?) salisburoides, Feistmantel, Uhlonosné útvary v Tasmánii, 1890, p. 100, t. 9, f. 1, 1a.

Obs.—Mr. R. M. Johnston has figured this plant, and Feistmantel has copied his figures, under two forms—a palmate or flabellate entire frond, and a similar shaped leaf broken up into four rather cuneate lobes, with a distinctly Sagenopteroid venation. The plant represented in Pl. VII, Figs. 2, displays a leaf of the first order with an entire margin, and in Fig. 3, one more or less segmented, with the edge further subdivided. The degree of variation shown in Johnston's figures will, I believe, admit the present leaves within his species. The venation seems identical, the nervules springing from two or three prominent nerves at the base of each leaf, and then anastomosing to form a delicate mesh. In Fig. 3 the leaf is attached to a stem that is prolonged upwards, but is not absolutely continuous with the higher portion, giving off two terminal leaves or pinnules, similarly veined. The attachment of the main leaf is a definite one, and as the smaller wedge-shaped leaves are similarly reticulated, they are presumed to be one and the same. If this plant really be a *Sagenopteris*, the form of the frond, so far as preserved, forces on us a somewhat different conception of the method of attachment of the pinnules and branching of the stem to that usually met with in the genus.

The specimen was collected by Mr. E. F. Pittman, A.R.S.M., from the same locality and series as the last fossil, at a depth of one thousand four hundred and ten feet to one thousand four hundred and seventeen feet six inches.

3. SPIRIFERA DUODECIMCOSTATA, *McCoy.*

Pl. VII, Figs. 4–8.

Spirifera duocecimcostata, McCoy, Ann. Mag. Nat. Hist., 1847, XX, p. 234, t. 17, f. 2 and 3.
Spirifer duodecimcostatus, Dana, Wilkes' U. S. Explor. Exped., 1849, X (Geol.), p. 684, Atlas., t. 2, f. 1, a and b.
Spirifer duodecimcostatus, De Koninck, Foss. Pal. Nouv.-Galles du Sud, 1877, Pt. 3, p. 254 (*excl. figs.*)

Obs.—An opportunity is afforded me of figuring the almost complete form of this species, and its surface sculpture. The general characters have been sufficiently well described by Profs. McCoy and De Koninck. In the first place it will be noticed (Pl. VII, Fig. 5.) that the area is very wide, triangular, extending the whole length of both valves, and is transversely striated and vertically lined.

The fissure is very large and widely triangular. The surface bears numerous imbricating laminæ of shell growth, wide apart above, but following one another with great rapidity towards the front. The surface of the laminæ is occupied by innumerable wavy microscopic concentric lines, and these are crossed by equally plentiful and delicate radiating lines (Pl. VII, Fig. 6), both on the costæ and in the intercostal spaces, producing the finest possible reticulation. Over the whole was a thin epidermal covering of a fibro-punctate rugose nature, consisting of very minute elongately tear-shaped pustules (Pl. VII, Figs. 7 and 8).

We are indebted for the original of Figs. 4 and 5 to Mr. John Waterhouse, M.A., Inspector of Schools, who obtained it from the hard nodular concretions of the Upper Marine Series, struck in the Maitland Colliery Co.'s Shaft, near Farley, Co. Northumberland. The surface ornament is drawn from an example collected by Mr. J. A. Wall, from the Upper Marine Series at Gerringong, Illawarra.

4. *Additional Evidence of* ENTOLIUM.

Genus Entolium, Meek, 1865.

Pl. VII, Fig. 15.

Entolium, Meek, Pal. California, 1865, App. I, p. 478.
„ Meek, Hayden's Final Report, Geol. Survey Nebraska, 1872, p. 189.
„ Etheridge fil., Ann. Mag. Nat. Hist., 1878, p. 30.
Pernopecten (pars), Hall, Pal. N. York, 1885, V, Pt. 1, No. 2, pl. VII.
Entolium, De Koninck, Ann. Mus. R. Hist. Nat. Belg., XI (Faune Calc. Carb., Pt. 5), 1885, p. 240.
„ (*Pernopecten*), Etheridge fil., Geol. Pal. Queensland, 1892, p. 264.

Obs. In common with other observers I have always used the name ***Entolium*** for this group of shells (Pl. VII., Fig. 15), but Professor James Hall has endeavoured to show the identity of Meek's genus with ***Pernopecten***, Winchell, in his remarks cited above. Without entering on all the details of the subject, there lucidly set forth, it will be sufficient to say that Winchell's type, ***Aviculopecten limiformis***, White and Whitfield (non Morris), in addition to its other peculiarities, bears a series of every minute crenulations on the hinge-plate. But the shell selected by Meek as the type of his genus, ***Pecten demissus***, Phill., is devoid of these crenulations, although in other respects agreeing with *A. limiformis*. Hall remarks that in the latter the crenulated hinge-plate is "often obscure or concealed, and the crenulations are easily abraded by friction." I have never seen such a structure on any of the numerous European examples of ***Entolium*** that have passed through my hands, nor on the limited number of Australian—and Professor De Koninck's evidence was clearly similar, for he says that *Pernopecten* seems to differ from ***Entolium***—"by the existence of a series of tubercles along the cardinal margin" (=hinge-plate of Hall). Either, therefore, Hall's view of the rapid abrasion

of these crenulations is correct, or we have, following Meek and De Koninck, two distinct types, one with, and the other without a crenulated hinge-plate. This is, at present, my opinion, and leaving the final solution to those in possession of more satisfactory material, I tentatively retain *Entolium* for shells similar to *Pecten demissus*, Phill., and *Aviculopecten Sowerbii*, M'Coy, the British types. This is perfectly justifiable until the latter and their Australian brethren have been proved, which at present is not the case, to possess the crenulations of *Pernopecten*.

We are acquainted with this genus from two localities in New South Wales, both in the Carboniferous, or at any rate, in rocks believed to fall into this series.

The figured valve (Pl. VII., Fig. 15) is oval, longer than broad, narrowing towards the cardinal margin and slightly oblique. The ears are nearly equal, horizontal, and not elevated above the umbone; the ligamentary pit shallow, but the transverse furrows in the ears are not visible. The surface is covered with fine concentric and very numerous lines, but no radiating lines or costæ.

In general form the present shell approaches *E. aviculatum*, Geinitz, sp., and *E. Sowerbii*, M'Coy, sp., more than any others, except that the ears are not elevated-conate, for possibly it is a right valve. To some extent also it resembles *E. coloratum*, De Kon. It was collected from the Carboniferous beds of Somerton, Co. Parry, by Mr. Charles Cullen, of the Geological Survey of N. S. Wales.

The second example of *Entolium* is also a single valve, with the ears slightly elevated; the umbo small and delicate; the impressions of the long diverging teeth well preserved, dividing off the well-flattened sides of the valve. The thin papyraceous test bears fine, numerous, concentric lines as usual. This example was found by Mr. J. Waterhouse, M.A., in the Mirari Limestone, Dungog Road, nineteen miles from West Maitland, Co. Durham. I refrain, in anticipation of additional material, from applying a specific name to these shells.

5. *Further Structure of* GONIATITES MICROMPHALUS, *Morris, sp.*

Goniatites (Prolecanites?) micromphalus, Morris, sp.

Pl. VII., Figs. 9–14.

Bellerophon micromphalus, Morris, Strzelecki's Phys. Descrip. N. S. Wales, &c., 1845, p. 288, t. 18, f. 7.

" " Dana, Wilkes' U.S. Explor. Exped., 1849, X (Geol.), p. 708, t. 10, f. 6, *a* & *b*.

Goniatites micromphalus, De Koninck, Foss. Pal. Nouv.-Galles du Sud, 1877, Pt. 3, p. 339, t. 24, f. 5.

Obs.—Although more than one good description of the form of this species has appeared, yet so far as I know, the surface sculpture has not been described, nor have the septa been noticed. Several excellent specimens collected by Messrs. David and Waterhouse enable me to supply this deficiency to some extent.

The old growth stages are usually well shown in *G. micromphalus*, and judging from the backward re-entering angles in the middle line, the latter appear to have been much more acute in the younger than the older state, and to have become more openly curved as age progressed until, in that condition attained by one of the specimens now before me, the lip displays only a feeble sinuosity.

The sculpture consists of microscopic spiral and transverse lines, breaking the surface into a series of the smallest squares, presenting, when magnified, the appearance of a toothed or rasplike surface. The sutures are moderately close, but in no instance is the shell sufficiently clear of its cover to expose the lobes and saddles of an entire suture, but the accompanying figure (Pl. VII, Fig. 12) will convey an idea of the form and general appearance of these interesting details. Both the lobes and saddles are nearly similar in shape, broadly sagittiform, or somewhat club-shaped (sub-pyriform). As the ventral lobe is not visible the section to which this species belongs cannot be determined with certainty, but probably it falls within Hyatt's Prolecanitidæ, and may be referable either to *Sandbergeroceras*, Hyatt,* or *Prolecanites*, Mojsisovics. † The first is equal to the section Linguati of the Bros. Sandberger, and the latter to the Lanceolati of the same authors, or Æquales of Beyrich. On the other hand our shells have not a large umbilicus as in *Sandbergeroceras*, and the surface is not smooth as in *Prolecanites*. On the whole, and omitting from consideration the ventral lobe, they seem to come nearer to the latter. The lobes and saddles have quite the appearance of *Goniatites Henslowi*, Sby., ‡ and *G. serpentinus*, Phill., § both Carboniferous species, and now referred to this section. One other pecularity exists in this Goniatite, the existence of a more or less oval scar, visible when the sculpture layer has been removed from the shell. This always occurs on the back, or ventral side, just above the penultimate growth stage, or false mouth. It has the appearance of a gradual peeling off of successive layers of shell structure, and is present in several examples. It must therefore have some structural significance.

The present specimens of *G. micromphalus* were obtained from the Upper Marine Series (hard calcareous concretions), at the Maitland Colliery Co.'s Shaft, near Farley, and the Melbourne Coal Co.'s Shaft, at Richmond Vale, near East Maitland, by Professor T. W. E. David, B.A., and Mr. J. Waterhouse, M.A.

* Proc. Boston Soc. Nat. Hist. for 1882–83 [1884], XXII, p. 333.
† *Ibid*, p. 335.
‡ Phillips, Ill. Geol. Yorkshire, 1836, t. 20, f. 39.
§ *Ibid*, t. 20, *f*. 48–50.

PLATE I.

Fig. 1. North and south section, from Camp Creek Bore to Narrabeen Bore, across the Sydney Basin.

Fig. 2. North-east and east section, from the Liverpool Bore to the second Cremorne Bore.

Scale—Horizontal, 4 miles to 1 inch; vertical, 800 feet to 1 inch.

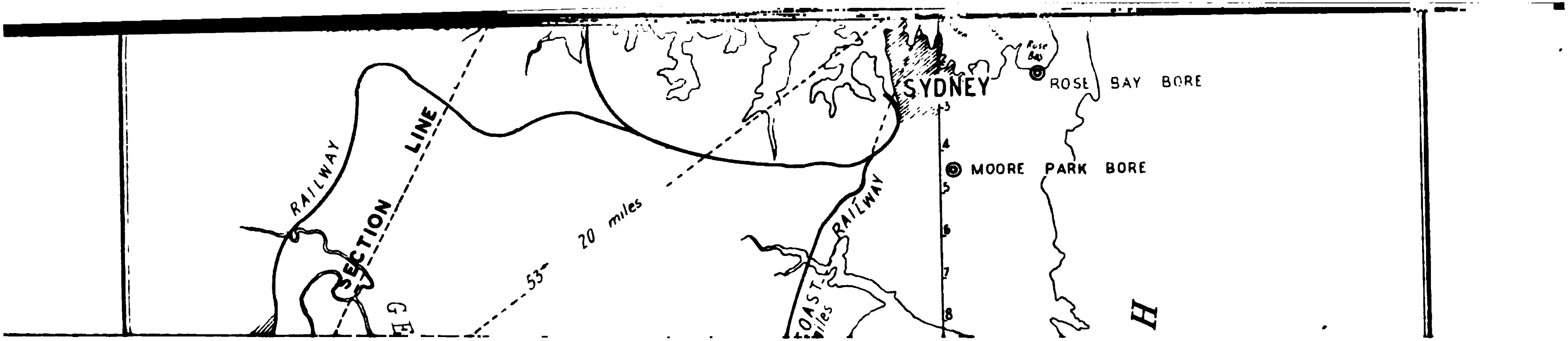
Plate reduced to two-thirds of the above scale.

38-1-7

PLATE II.

Plan showing position of Bores in the Sydney District.

Scale—4 miles to 1 inch.


SYDNEY
ROSE BAY BORE
Rose Bay
MOORE PARK BORE
RAILWAY
SECTION LINE
20 miles
53
COAST
RAILWAY
H
GE

2)

PLATE III.

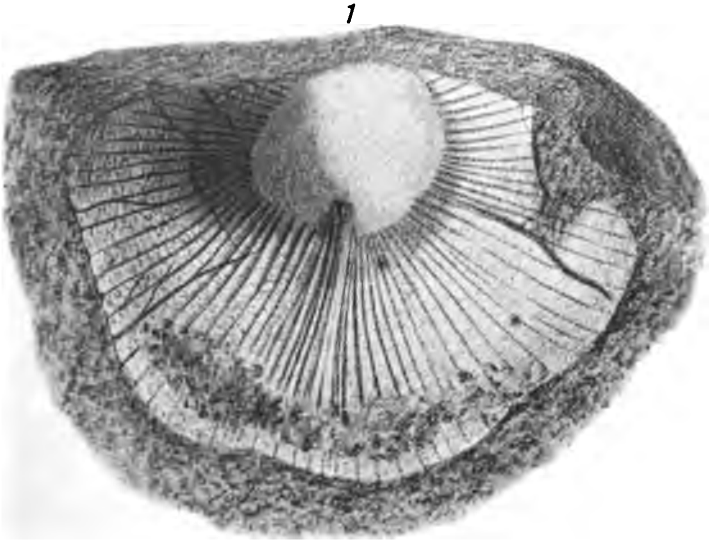
Mucophyllum crateroides, *Eth. fil.*

Fig. 1. The corallum seen from the truncated base, exhibiting the costæ, fimbriated edge, &c.

Fig. 2. The calice, showing the septa, fossula, and bare central tabulate area.

Drawn from nature by Mr. P. T. Hammond.

1



2

P.T. Hammond, del.

Heliotype.

PLATE IV.

Mucophyllum crateroides, *Eth. fil.*

Fig. 1. The corallum seen from the base, with remains of the radiciform processes.

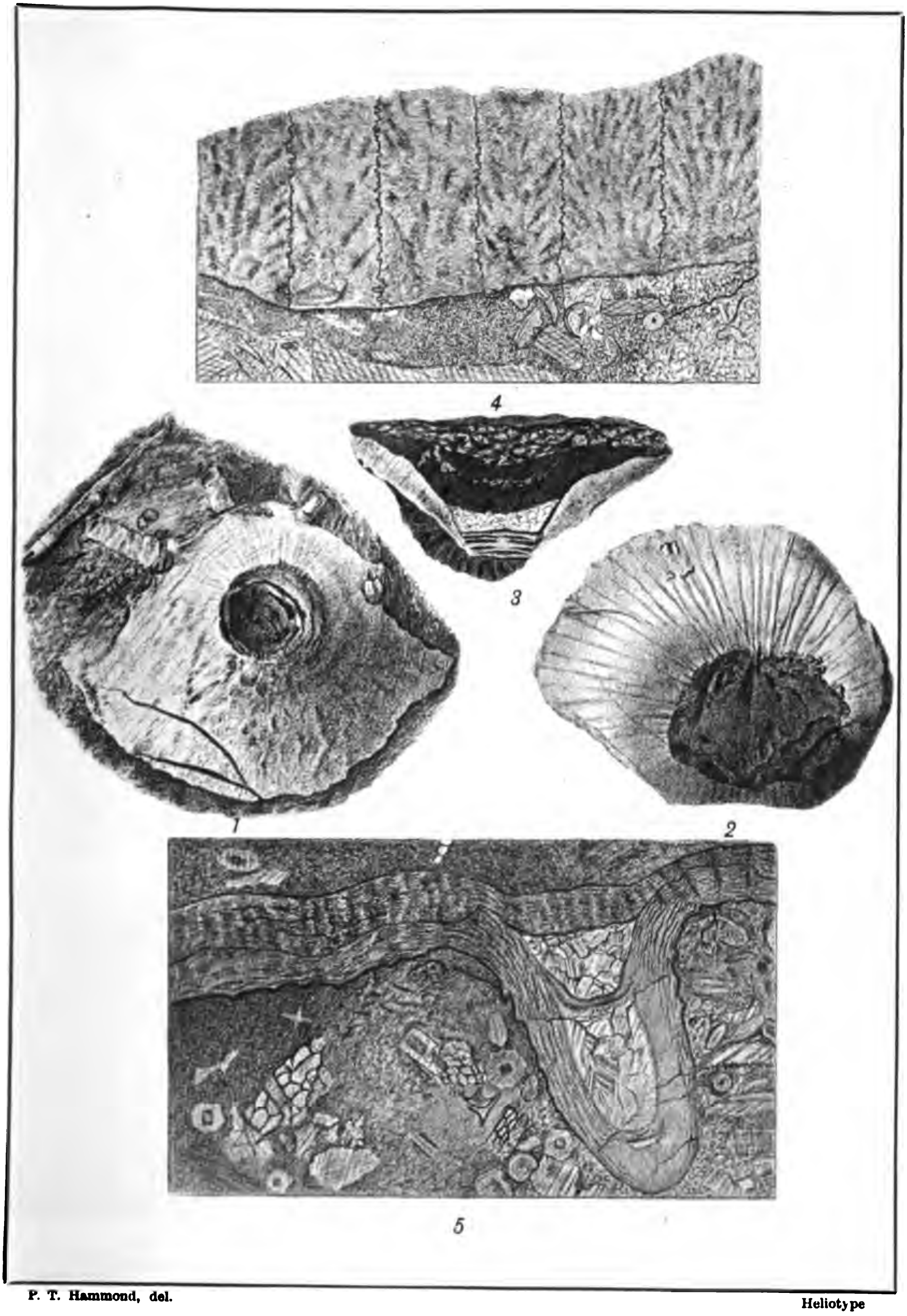
Fig. 2. The calice partially filled with matrix.

Fig. 3. Section of a small corallum, displaying thickness of the walls and tabulæ.

Fig. 4. Horizontal section, showing five simple fluctuating septa—x $7\frac{1}{2}$.

Fig. 5. Vertical section of a portion of the corallum with one of the hollow radiciform processes, tabulate—x $7\frac{1}{2}$.

Drawn from nature by Mr. P. T. Hammond.



P. T. Hammond, del.

Heliotype

PLATE V.

Diprotodon, *sp.*

Fig. 1. Third cervical vertebra, anterior aspect.

Fig. 2. Do do posterior aspect.

Drawn from nature by Mr. P. T. Hammond, one-half natural size.

1

2

P.T. Hammond, del. Heliotype.

PLATE VI.

Pteronites Pittmani, *Eth. fil.*

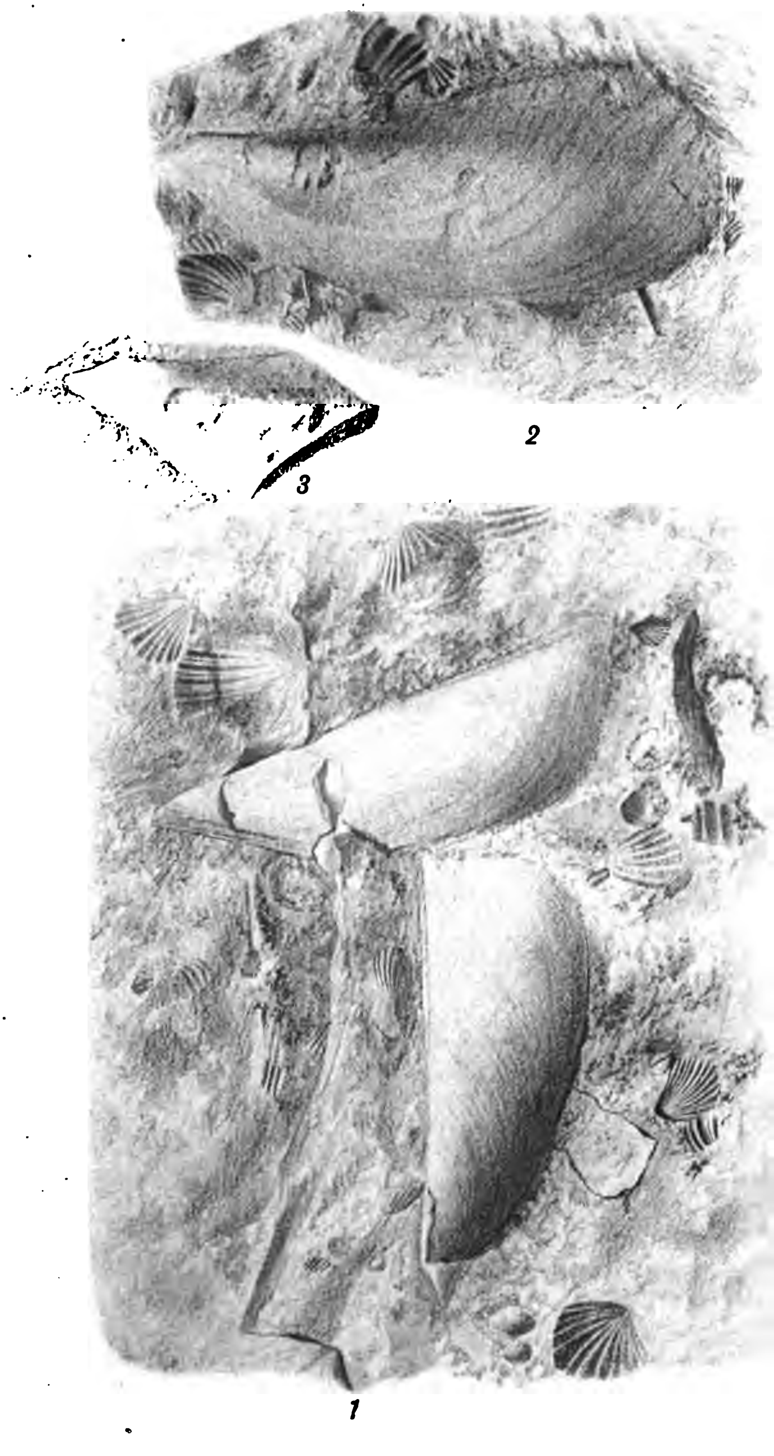
Fig. 1. Two individuals of medium size.

Fig. 2. A specimen that has attained maximum growth.

Fig. 3. Anterior end of a smaller example.

The drawings all represent left valves, and show the acute anterior ends, the concentric laminæ, and intermediate fine striæ.

Drawn from nature by Mr. P. T. Hammond.



P. T. Hammond, del. Heliotype.

PLATE VII.

Schizoneura (?) *sp.*

Fig. 1. Cross section of a stem and portions of three leaves.

Sagenopteris salisburoides, *Johnston* ?

Fig. 2. Leaf or pinnule with partly scalloped, partly broken margin.

Fig. 3. An entire pinnule attached to a stem, with smaller pinnules above.

Spirifera duodecimcostatus, *McCoy*.

Fig. 4. View of the dorsal valve, and ventral umbo.

Fig. 5. View of conjoined valves, area, and fissure.

Fig. 6. Surface sculpture magnified.

Fig. 7. Sculpture of the epidermal layer, natural size.

Fig. 8. The same more highly magnified.

Goniatites (Prolecanites ?) micromphalus, *Morris*.

Fig. 9. Side view of a full grown individual.

Fig. 10. Similar view of a smaller specimen showing the umbilicus.

Fig. 11. The same seen from the back, or ventral side, showing the slightly emarginated lips, and the oval scar above the penultimate growth stage.

Fig. 12. The lobes and saddles.

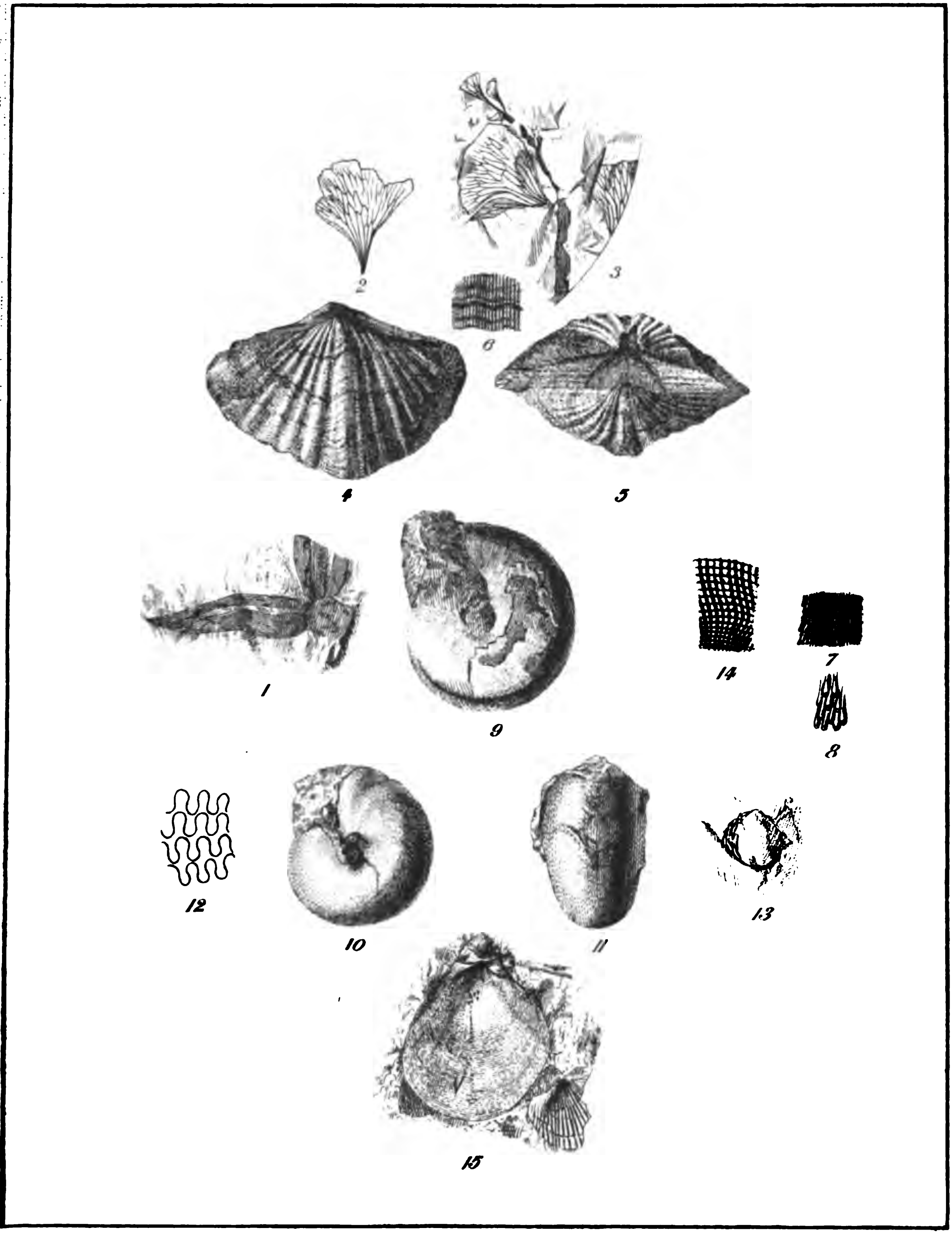
Fig. 13. The oval scar on the back or ventral side.

Fig. 14. The sculpture magnified.

Entolium, *sp.*

Fig. 15. Valve, probably the left, seen from the interior.

Drawn from nature by Mr. P. T. Hammond.



P.T. Hammond del.

(11268-94)

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CATALOGUE OF MINING MAPS

PUBLISHED BY THE

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APRIL, 1894.

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MINING DISTRICTS.

[P]arish, or part of.	Mining District.	Gold-field.
...rombie (part of)	Tumut and Adelong ..	Umaralla.
...ong (part of) ..	do do ..	Adelong Creek.
...e do	Peel and Uralla........	Swamp Oak and Niangala.
[illegible]	Mudgee	
...rt	Albert	Albert.
...rta	do	do
...ry	Tumut and Adelong ..	Black Range (partly).
...a	Albert	Albert.
... (town of)....	do	do
...son	Peel and Uralla........	Tingha.
...dale	New England	Emmaville (partly).
... (part of)	Bathurst	
...ony	New England	Boorook and Lunatic.
... (part of)	Bathurst	Caloola Creek (partly).
...d	New England..........	Emmaville (partly).
[illegible]	Peel and Uralla........	Tingha.
...a	Hunter and Macleay ..	
...rrigarn	Albert	Albert.
...a	Clarence and Richmond	Orara.
...Nobs..........	Peel and Uralla........	
...aba (part of)..	Tumut and Adelong ..	Molonglo (partly).
...dean	New England..........	
... .	Clarence and Richmond	Tweed and Richmond Rivers (partly).
...mora	Tambaroora, and Turon, and Mudgee.	Turon River (partly).
...eet	Peel and Uralla........	Bingara (partly).
... (part of)..	do do	do do
... .	Bathurst	Oberon.
...y Downs......	New England..........	Boorook and Lunatic.
...rangee (part of)	Albert	Albert.
... (part of)......	New England..........	Emmaville.
...ee	Bathurst	Beneree (partly).
...gmee	Southern..............	Dromedary.
...ma............	do	
...arre..........	do	
...ra	Hunter and Macleay ..	Barrington and Gloucester.
...ra	Peel and Uralla........	Bingara.
...o (part of) ..	do do	do
... .	New England..........	Emmaville.
...heath	Bathurst	
... .	New England..........	Emmaville.
... .	Albert	Albert.
...ome	Peel and Uralla........	
...dura (part of).	Tambaroora and Turon.	Macquarie River, Stony Creek, and Ironbarks
... (part of)	do do ..	Wellington.
...a	Albert	Albert.
...ah	Bathurst	Mulgunnia and Abercrombie.
...piah	Albert	Albert.

Parish, or part of.	Mining District.	Gold-field.
Bookookara (pt. of)	New England..........	Boorook and Lunatic.
Do do ..	do do	do do
Booloombayt	Hunter and Macleay ..	Gloucester.
Boona	Cobar	Bogan.
Do East........	do	do
Do West........	do	do
Boonoo Boonoo (pt. of).	New England..........	Boorook and Lunatic.
Boorook	do do	do do
Boranel	Hunter and Macleay ..	Gloucester.
Bowman	New England..........	Emmaville.
Boyd	Peel and Uralla........	
Brangalgan	Tumut and Adelong ..	Bourke, Cooper, Dowling, and Gipps.
Branxton	Hunter and Macleay ..	
Bray	Albert	Albert.
Bringellet (part of).	Bathurst	Caloola Creek.
Broadmeadows	Clarence and Richmond	Boyd or Little River.
Broulee (& Tomago)	Southern..............	Mogo (partly).
Brundah	Lachlan	Tyagong Creek.
Buangla (part of) ..	Southern..............	Yalwal.
Bullongong do	Tumut and Adelong ..	Molonglo (partly).
Bumbaldry	Lachlan	Tyagong Creek.
Bundar	New England..........	Emmaville (partly).
Bundawarrah	Lachlan	Temora (partly).
Do (part of)	do	do do
Burke	Southern..............	
Burra	Cobar	Bogan.
Burrandong	Tambaroora and Turon.	Macquarie River, Stony Creek, Ironbarks, and Wellington.
Do (part of)	do do ..	Macquarie River, Stony Creek, and Ironbarks.
Burrill	Lachlan	Bogan.
Byjerkerno	Albert	Albert.
Byng	Bathurst	Byng (partly).
Byngrano	Albert	Albert.
Cadger	Southern..............	Gulph (partly).
Calafat	Tumut and Adelong ..	Adelong Creek.
Callanyn (part of) ..	New England..........	Boorook and Lunatic.
Caloola (part of)....	Albert	Albert.
Canowindra	Bathurst	Canowindra (partly).
Carroll (part of)	Tambaroora and Turon.	Wellington.
Cargo	Lachlan	Cargo and Canowindra.
Do (part of)	do	Cargo.
Castleton	Bathurst	Turon River and Kirkconnell.
Cataract (part of) ..	New England	Boorook and Lunatic (partly).
Cathcart	Albert	Albert.
Cavendish..........	New England	Timbarra and Boorook and Lunatic.
Cessnock	Hunter and Macleay ..	

Parish, or part of.	Mining District.	Gold-field.
Chalmers (part of)	Peel and Uralla	Upper Hunter (partly).
Churchill do	New England	Solferino.
Clare	Peel and Uralla	Tingha.
Clarence (part of)	New England	Tooloom Creek.
Clifford do	Tumut and Adelong	Umaralla.
Clinton	Bathurst	Ophir.
Clive	Peel and Uralla	Tingha.
Coally (part of)	Albert	Albert.
Cobar	Cobar	Bogan.
Cole (part of)	Bathurst	Newbridge (partly).
Collett	Lachlan	Canowindra.
Colongon	New England	Boorook and Lunatic.
Comlaroi	Clarence and Richmond.	Orara.
Cooba	Bathurst	
Coolamin	Tambaroora and Turon.	Macquarie River, Stoney Creek, and Ironbarks.
Coolamigal	Bathurst	Turon River.
Coonbaralba	Albert	Albert.
Cooney	Peel and Uralla	Gyra River.
Do (part of)	do do	do
Coorumbung	Hunter and Macleay	
Cope's Creek	Peel and Uralla	Tingha.
Corella	Cobar	Bogan.
Coniston	Southern	
Corona	Albert	Albert.
Corry (part of)	New England	Boorook and Lunatic.
Coventry	Peel and Uralla	Kookarabooka.
Cox	Bathurst	
Cranbrook (part of)	New England	Emmaville.
Craven	Hunter and Macleay	Gloucester.
Cullen Bullen	Bathurst	Turon River (partly).
Cullendore	New England	
Cummings (part of)	Tambaroora and Turon	Wellington.
Carragurra do	do do	Macquarie River, Stony Creek and Ironbarks.
Currajong do	Lachlan	Billabong.
Currambene	Southern	Cooloomgatta (partly).
Currocki	Hunter and Macleay	Gloucester.
Dalmorton (part of)	Clarence and Richmond.	Boyd or Little River.
Danjerra do	Southern	Yalwal.
Darby	Peel and Uralla	Tingha.
Derra Derra	do do	Bingara (partly).
Do (part of)	do do	do do
Dening	Albert	Albert.
Dhoon	do	do
Digby	Peel and Uralla	
Dinoga	do do	Bingara.
Do (part of)	do do	do
Dumaresq	New England	Emmaville.
Dungowan	Peel and Uralla	Peel River.
Dunleary (part of)	Bathurst	Milburn Creek.
Edgar	Albert	Albert.
Ellerslie	Cobar	Bogan.
Elsmore	Peel and Uralla	Tingha (partly).
Enmore	Albert	Albert.
Do	Peel and Uralla	Gyra River Extension.
Eskdale	Bathurst	Clear Creek and Kirkconnell (partly).
Ettrema	Southern	Yalwal.
Euadera (part of)	Tumut and Adelong	Adelong Creek (partly).
Eumur	Peel and Uralla	Ironbarks and Tea-tree.
Eusdale	Bathurst	Kirkconnell and Mount Lambie (partly).
Fairy Hill	Albert	Albert.
Falnash	Bathurst	Turon River (partly).
Fitzroy	Cobar	Bogan.
Flagstone	New England	Emmaville.
Forbes	Lachlan	Billabong and Lachlan, Wellington, Macquarie River.
Do (part of)	Bathurst	Stony Creek, Ironbarks, and Ophir.
Fowler's Gap do	Albert	Albert.
Freemantle do	Bathurst	Ophir (partly).
Fraser	New England	Emmaville.
Do	do	
Gadara (part of)	Tumut and Adelong	Adelong Creek (partly).
Gairdner's Creek	Albert	Albert.
Galbraith	Bathurst	Newbridge and Caloola Creek (partly).
Do (part of)	do	Newbridge (partly).
Gibraltar do	New England	

Parish, or part of.	Mining District.	Gold-field.
Giles (part of)	Albert	Albert.
Gillgurry do	New England	Boorook and Lunatic.
Gillenbine	Cobar	Bogan.
Gillindich	Bathurst	Junction Point, Tuena [illegible] and Markdale.
Glenken	Tumut and Adelong	Ourance Creek.
Gneupa	Southern	Pambula.
Gooloongolok	Hunter and Macleay	Gloucester.
Gordon	Peel and Uralla	
Gouron (part of)	do do	Bingara.
Greme	Hunter and Macleay	Nowendock and [illegible]
Gulgong	Mudgee	Gulgong.
Gulph (part of)	Southern	Gulph (partly).
Guntawang	Mudgee	Gulgong.
Hall	Peel and Uralla	Kookarabooka.
Do	do	Ironbark and Tea-tree.
Do	do	Bingara (partly).
Do (part of)	do	do
Hamilton	New England	Emmaville (partly).
Hampton	Bathurst	Bathula do
Hanning	Peel and Uralla	
Hargraves	Mudgee	Wellington.
Hartley	Bathurst	
Haystack	New England	Emmaville.
Heathcote	Southern	
Herbert	Peel and Uralla	Tingha.
Herborn	Hunter and Macleay	Orara.
Highland Home	New England	Emmaville.
Hughes	Albert	Albert.
Ironbarks (part of)	Tambaroora and Turon.	Macquarie River, Stony [illegible] Ironbarks, and [illegible]
Inverary	Southern	Nerrimunga.
Inverell	Peel and Uralla	
Jamberoo	Southern	
Jamieson	Bathurst	
Jallore	Southern	
Jarricknorra	do	Shoalhaven and [illegible] River (partly).
Jingellic East	Tumut and Adelong	Ourance Creek.
Joadja	Southern	
Jocelyn	Bathurst	Oberon.
Kahibah	Hunter and Macleay	
Kangaloon	Southern	
Kedumba	Bathurst	
Kembla	Southern	
Kirk	Albert	Albert.
Lake Macquarie	Hunter and Macleay	
Land's End	New England	Emmaville.
Langdale (part of)	Bathurst	Oberon (partly)
Lennox	do	Ophir do
Lewis	Albert	Albert.
Do (part of)	Bathurst	Ophir (partly).
Lidsdale	do	Mount Lambie (partly).
Loftus (part of)	Peel and Uralla	Swamp Oak and Niangala (partly).
Macintyre (part of)	do do	Bingara (partly).
Maharatta	Albert	Albert.
Mandamah (part of).	Lachlan	Barmedman (partly).
Mandolong	Hunter and Macleay	
Manildra	Lachlan	Dilga.
Marangaroo	Bathurst	
March (part of)	do	Ophir.
Marsh	New England	
Martin	Lachlan	Billabong.
Marulan	Southern	Argyle, Camden, and [illegible]
Maryland	New England	
Mayo	Peel and Uralla	Tingha.
Megalong	Bathurst	
Merrigalah (part of).	Peel and Uralla	Gyra River.
Metz	do do	do
Do (part of)	do do	do
Mickimill	Cobar	Bogan.
Milring (part of)	Albert	Albert.
Mingelo do	Mudgee	Tomingley.
Mitchell	Peel and Uralla	
Do (part of)	do do	Kookabookra and [illegible]
Molroy	do do	Bingara.
Mongarlowe	Southern	Mongarlowe River (partly).
Moonam (part of)	Peel and Uralla	Upper Hunter.
Moorkale	Albert	Albert.
Moquilamba	Cobar	Bogan.

Parish, or part of.	Mining District.	Gold-field.
[illegible]	Southern	Moruya (partly).
[illegible]	Mudgee	
[illegible]	Bathurst	
[illegible] Allen	Cobar	Bogan.
[illegible] Gipps	Albert	Albert.
[illegible] Hope	Cobar	Bogan.
[illegible] (part of)	Tambaroora and Turon.	Macquarie River, Stony Creek, Ironbarks, and Muckerwa.
do do	do do	do do
[illegible]	Lachlan	Billabong.
[illegible]	New England	Emmaville.
[illegible]	Bathurst	Mulgunnia and Abercrombie (partly).
[illegible]	Albert	Albert.
[illegible]	Tumut and Adelong	Black Range (partly).
[illegible]	Cobar	Bogan.
[illegible]	Peel and Uralla	Bingara.
[illegible]	Albert	Albert.
[illegible]	do	do
[illegible]	Southern	Argyle, Camden, and King.
[illegible]	Bathurst	
[illegible] (part of)	Southern	Gulph (partly).
[illegible]	do	Nerrimungah Creek.
[illegible] England Mining District.		
[illegible]	Peel and Uralla	Ironbark and Tea-tree (partly).
[illegible]	Hunter and Macleay	Orara.
[illegible]	Southern	Dromedary.
[illegible] (part of)	do	do
[illegible] do	Albert	Albert.
[illegible]	Clarence and Richmond	Boyd or Little River (partly).
[illegible] (part of)	Peel and Uralla	Peel River (partly).
[illegible]	Clarence and Richmond	Tweed and Richmond Rivers.
[illegible] (part of)	Southern	Shoalhaven and Shoalhaven River.
[illegible]	Bathurst	Oberon.
[illegible] (part of)	Peel and Uralla	Upper Hunter.
[illegible]	Hunter and Macleay	
[illegible]	Peel and Uralla	Upper Hunter.
[illegible]	Albert	Albert.
[illegible]	Southern	Argyle, Camden, and King.
[illegible] (part of), Mount Brown.	Albert	Albert.
[illegible]	do	do
[illegible]	do	do
[illegible] North	New England	Emmaville.
[illegible]	Lachlan	Billabong.
[illegible]	Albert	Albert.
[illegible] (part of)	Peel and Uralla	Upper Hunter.
[illegible]	Albert	Albert.
[illegible] (part of)	New England	Emmaville.
[illegible] do	do do	Boorook and Lunatic.
[illegible]	Albert	Albert.
[illegible]	New England	Emmaville.
[illegible]	do do	do
[illegible] (part of)	do do	do
[illegible] Valley do	Tumut and Adelong	Umaralla.
[illegible]	New England	Boorook and Lunatic (partly).
[illegible]	Peel and Uralla	
[illegible] (part of)	do do	Kookarabooka.
[illegible] do	do do	do
[illegible]	Cobar	Bogan.
[illegible]	Peel and Uralla and New England.	Emmaville (partly).
[illegible]	Peel and Uralla	
[illegible]	Tumut and Adelong	Sebastopol, Junee, and Urangilly (partly).
[illegible]	Albert	Albert.
[illegible] (part of)	Peel and Uralla	Kookarabooka.
[illegible]	Albert	Albert.
[illegible] (part of)	Peel and Uralla	
[illegible] Grove (pt. of)	New England	Emmaville (partly).
[illegible]	Peel and Uralla	Tingha do
[illegible]	Tambaroora and Turon.	Turon River.
[illegible] (part of)	Bathurst	Gully Swamp and Black Hills (partly).
[illegible]	Cobar	Bogan.
[illegible]	Albert	Albert.
[illegible]	Southern	
[illegible] Gundagai	Tumut and Adelong	Adelong Creek and Gundagai.

Parish, or part of.	Mining District.	Gold-field.
Springbrook	Clarence and Richmond	Boyd or Little River.
Stanford	Hunter and Macleay	
Stephen	Albert	Albert.
Stockington	Hunter and Macleay Extended.	
Stockton	Hunter and Macleay	
Do (town of)	do do	
Stonehenge	Peel and Uralla	
Stowell	Hunter and Macleay	
Strachan	New England	Emmaville (partly).
Strathbogie	do do and Peel and Uralla.	do do
Do North	New England	do do
Strathspey (part of)	do do	Boorook and Lunatic.
Sutton	Hunter and Macleay	
Swinton	Peel and Uralla	Tingha.
Talbragar	Mudgee	Gulgong.
Tallaganda (part of)	Southern	
Tambaroora do	Tambaroora and Turon.	Wellington.
Tara	Albert	Albert.
Teleraree	Hunter and Macleay	Gloucester (partly).
Tenandra	Mudgee	Mitchell's Creek.
Tent Hill	New England	Emmaville (partly).
Teralba	Hunter and Macleay	
Thornshope	Bathurst	Mount Lambie.
Tienga	Peel and Uralla	
Timbarra	New England	Boorook and Lunatic, and Timbarra.
Tomago	Southern	Mogo (partly).
Tomaree	Hunter and Macleay	
Toogong	Lachlan	Cargo and Canowindra (partly).
Topi Topi	Hunter and Macleay	Gloucester.
Torrorwangee	Albert	Albert.
Torrens (part of)	Bathurst	King's Plains.
Tont	Cobar	Bogan.
Trianbil (part of)	Tambaroora and Turon.	Wellington.
Trigalong	Lachlan	Temora.
Tuena	Bathurst	Abercrombie.
Tuggarah	Hunter and Macleay	
Tumbarumba	Tumut and Adelong	Tumbarumba, Ournie, and Burra Creek (partly).
Undercliff (part of)	New England	Boorook and Lunatic.
Undoo do	Tumut and Adelong	
Umberumberka	Albert	Albert.
Ulmarrah (part of)	Tambaroora and Turon.	Wellington.
Urobodalla do	Southern	
Walcha	Peel and Uralla	Swamp Oak and Niangala.
Wallah Wallah	Lachlan	Lachlan.
Wallundry	do	Gundabindyal.
Walters (part of)	Tambaroora and Turon.	Wellington.
Wangat	Hunter and Macleay	Gloucester.
Warragamba	Bathurst	
Warratra (part of)	Mudgee	Wellington.
Warre Warral	Tumut and Adelong	Sebastopol, Junee, and Urangilly.
Waukaroo	Albert	Albert.
Wellington North	New England	Emmaville (partly).
Wellington Vale	do do	do do
Wells	Tambaroora and Turon.	
Wertago	Albert	Albert.
West Fairfield	New England	Timbarra.
Willie Ploma	Tumut and Adelong	Adelong Creek.
Willyama, (village of)	Albert	Albert.
Windeyer (part of)	Mudgee	Wellington.
Wonona	Southern	
Wongawilli	do	
Wood's Reef	Peel and Uralla	Iron-bark and Tea-tree.
Woraro	Albert	Albert.
Worcester	Bathurst	Ophir.
Worra	Peel and Uralla	Kookarabooka.
Wyaldra	Mudgee	Gulgong.
Wyanbene	Southern	
Wylie	New England	Boorook and Lunatic (partly).
Yalwal (part of)	Southern	Yalwal.
Yarcowinna	Albert	Albert.
Do North	do	do
Yarralaw	Southern	Argyle, Camden, and King.
Young (part of)	Lachlan	Burrangong.
Yowaka	Southern	Pambula.
Do (part of)	do	do

GEOLOGICAL MAPS AND PUBLICATIONS ISSUED BY THE DEPARTMENT OF MINES AND AGRICULTURE, SYDNEY.

(1.) MAPS.

Map showing Mineral Areas of New South Wales. Scale, 16 miles to 1 inch.
Do do do Scale, 50 miles to 1 inch.
Geological Sketch Map of New South Wales, compiled from the Maps of the late Rev. W. B. Clarke, M.A., F.R.S., by C. S. Wilkinson, L.S., F.G.S., Government Geological Surveyor-in-charge. Scale, 8 miles to 1 inch.
Do do do do Scale, 22 miles to 1 inch.
Geological Map of the Districts of Hartley, Bowenfells, Wallerawang, and Rydal, by C. S. Wilkinson, L.S., F.G.S.
Geological Map of Hill End and Tambaroora, by E. F. Pittman, Geological Surveyor.
Geological Map of the Vegetable Creek Tin-mining District, by T. W. E. David, B.A., F.G.S., Geological Surveyor. Scale, 58 chains to 1 inch.
Index Map of the Vegetable Creek Tin-fields, by T. W. E. David, B.A., F.G.S. Scale, 80 chains to 1 inch.
Geological Map of the Forest Reefs District, by H. Y. L. Brown, Geological Surveyor.
Map of the Silver-mining Country, Barrier Ranges, by C. S. Wilkinson, L.S., F.G.S.
Vertical Sections of New South Wales Upper Coal Measures, by John Mackenzie, F.G.S., Examiner of Coal-fields.
Diagrams showing the Thickness, Character, and Portion mined out of Coal-seams in the Coal Measures of New South Wales, by John Mackenzie, F.G.S., Examiner of Coal-fields.
Plans showing the Outcrop, Thickness, and Dip of the Coal-seams in the Northern, Southern, and Western Coal-mining Districts of New South Wales, by John Mackenzie, F.G.S., Examiner of Coal-fields.
Geological Sketch Map showing boundary of the Cretaceo-Tertiary Formation in the County of Cowper, by William Anderson, Geological Surveyor, 1889.
Geological Sketch Map of Tertiary Deep Lead, Tumberumba, by William Anderson, 1890.
Sketch Map showing Geological Features between Peak Hill and Tomingley, by William Anderson, 1890.

(2.) PUBLICATIONS.

The Mining Act of 1881, with Regulations.
Annual Reports from 1875 to 1893 inclusive.
Mines and Mineral Statistics, 1875. [Out of print.]

MINERAL PRODUCTS OF NEW SOUTH WALES, 1882, containing :—
1. Mineral Products of New South Wales, by Harrie Wood, J.P., Under Secretary for Mines.
2. Notes on the Geology of New South Wales, by C. S. Wilkinson, L.S., F.G.S., Geological Surveyor-in-Charge.
3. Description of the Minerals of New South Wales, by Archibald Liversidge, M.A., F.R.S., F.C.S., F.G.S., &c., Professor of Chemistry and Mineralogy in the University of Sydney.
4. Catalogue of Works, Papers, Reports, and Maps on the Geology, Palæontology, Mineralogy, &c., &c., of the Australian Continent and Tasmania, by Robert Etheridge, Junr., of the British Museum, and Robert Logan Jack, F.R.G.S., F.G.S., Government Geologist for Queensland.

MINERAL PRODUCTS OF NEW SOUTH WALES, 2nd Edition, 1886, containing :— [Out of print.]
1. Mineral Products of New South Wales, by Harrie Wood, J.P., Under Secretary for Mines.
2. Notes on the Geology of New South Wales, by C. S. Wilkinson, L.S., F.G.S., Geological Surveyor-in-Charge.
3. The Collieries and Boghead Mineral Mines of New South Wales, by John Mackenzie, F.G.S., Examiner of Coal Fields.

MEMOIRS OF THE GEOLOGICAL SURVEY OF NEW SOUTH WALES.

Geology.
1. Report on the Vegetable Creek Tin Mining District, by T. W. E. David, B.A., F.G.S., Geological Surveyor.
5. Geology of the Broken Hill Lode and Barrier Ranges Mineral Field, New South Wales, by J. B. Jaquet, A.R.S.M., &c. (4to. Sydney, 1894.)

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1. The Invertebrate Fauna of the Hawkesbury-Wianamatta Series of New South Wales, by Robert Etheridge, Junr., Palæontologist to the Geological Survey of New South Wales, and Australian Museum, Sydney. (4to. Sydney, 1888.)
2. Contributions to the Tertiary Flora of Australia, by Dr. Constantin, Baron von Ettingshausen, Prof. of Botany, University of Graz, Austria. (4to. Sydney, 1888.)
3. Geological and Palæontological Relations of the Coal and Plant-bearing Beds of Palæozoic and Mesozoic Age in Eastern Australia and Tasmania, by Ottokar Feistmantel, M.D. (4to. Sydney, 1890.)
4. The Fossil Fishes of the Hawkesbury Series at Gosford, by A. S. Woodward, &c. (4to. Sydney, 1890.)
5. A Monograph of the Carboniferous and Permo-Carboniferous Invertebrata of New South Wales. Part I. Cœlenterata: Part 2, Echinodermata, &c.; by R. Etheridge, Junr. (4to. Sydney, 1891-92.)
7. The Mesozoic and Tertiary Insects of New South Wales, by R. Etheridge, Junr., &c., and A. Sidney Olliff, &c. (4to. Sydney, 1890.)
8. Contributions to a Catalogue of Works, Reports, and Papers on the Anthropology, Ethnology, and Geographical History of the Australian Aborigines, Parts I and II; by R. Etheridge, Junr. (4to. Sydney, 1890-92.)

RECORDS OF THE GEOLOGICAL SURVEY OF NEW SOUTH WALES.
Vols. I—III (Sydney, 1889-93.) IV, Pt. 1. (Sydney, 1894.)

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DEPARTMENT OF MINES AND AGRICULTURE, SYDNEY.

RECORDS

OF THE

GEOLOGICAL SURVEY OF NEW SOUTH WALES.

Vol. IV.] 1894. [Part II.

XI.—On certain Coal and Shale Lands in the Capertee Valley District, embraced within the Parishes of Ben Bullen, Coco, Airley, Morundurey, Umbiella, Goongal, and Clandulla, in the County of Roxburgh, and Marangaroo, in the County of Cook, New South Wales: by Joseph E. Carne, F.G.S. Geological Surveyor.

I.—Physical Geography.

The country examined embraces the well-known features of the Blue Mountain scenery—high precipitous escarpments of sandstone with sloping flanks of clay shales, walling in valleys, some narrow and confined, others opening out into large amphitheatres, such as the Capertee Valley. In these denuded low-lying areas, isolated outliers of the sandstones and shales—such as Genowlan, Airley, and Crown Mountains—stand out like islands.

The Capertee Valley is drained by the Capertee River and its tributaries, Coco and Umbiella Creeks, and minor channels. The flow is eastward into the Hawkesbury River, and it is along the course of the former river that the Colo Valley railway trial survey has been run to avoid the ascent of the Blue Mountains.

The general fall of the country is to the north-east.

II.—General Geology.

Devonian.—The basal rocks exposed in the area in question consist of quartzites, slates, sandstones, and limestones of Devonian age. The quartzites and sandstones vary in texture from fine to coarse grain, and are fossiliferous in bands which are recognisable by the gossany fretted appearance of the outcrop, resulting, probably, from the precipitation of the iron oxide by the organic matter, and subsequent removal of the lime covering of the marine mollusca, the remains of which are abundant.

The only trace of a fossil flora discovered in these rocks, in the limited time available for search, was an indeterminable cast of a small stem.

The slates, particularly near the limestones, have a schistose character, and are nearly vertical. No traces of organic remains were found in them so far as examined.

The limestone occurs interbedded in the slates and quartzites. The main bed strikes—with the former rocks—across the valley in a N.N.W. direction. Rising in a high precipitous bluff near Mount Stewart, on the eastern boundary of the Parish of Goollooenboin, Co. Cook, it passes close to Crown Mount on the north-east side, thence through the north-eastern corner of the Parish of Coco, County Roxburgh, and under the Morundurey and Genowlan Mountains, making again at the surface in the Parish of Clandulla, on the north-west. The maximum thickness of the bed is about two-thirds of a mile. The total width of the exposure of Devonian rocks is about three miles.

In addition to the main belt of limestone numerous narrow beds occur at intervals in the quartzites and slates.

The quartzites and slates contain numerous small quartz veins, and it is probable that it was from this source that the gold was originally derived which was worked some years ago in the small patch of alluvial in Nuggety Gully, near the north-east corner of the Parish of Coco, or possibly from the degradation of a granite intrusion in the Devonian rocks, as in the case near Rydal described by the late Mr. C. S. Wilkinson*; but in either case the occurrence of gold in Nuggety Gully is not likely to extend beyond the small patch alluded to.

Near the limestone belt between the ten and twelve mile marked trees on the road between Capertee and Glen Alice, a narrow gossan leader occurs which is said to have yielded a small quantity of gold and silver.

The Devonian sedimentary rocks crop out also in Gallagher's Creek, about two and a half miles from Capertee, on the Glen Alice Road, and again near Airley Turret, both localities in the Parish of Coco. In the Parish of Clandulla, west of Portion 70, on the line of strike of the main belt in Goollooenboin, Devonian slates crop out in a small creek falling into Main Swamp.

* Min. Prod., N. S. Wales, 2nd Ed., 1887, p. 92.

Permo-Carboniferous (Upper Marine Group.)—Resting unconformably upon the upturned edges of the Devonian strata are beds of mudstones and shales filled with large boulders and pebbles of the underlying quartzites, and occasionally of granite. The base of these beds is coarsely conglomeratic, and is especially characterized by the size of the quartzite erratics. The upper beds are mudstones with more sparsely distributed rounded boulders and pebbles, and fine shaly sandstones, which present a marked concretionary structure in places. The top bed of the series consists of a thin bed of clay shale. The thickness of the Upper Marine beds in the Capertee Valley ranges from three hundred to five hundred feet.

Excellent sections, showing an unconformable junction with the underlying Devonian rocks, occur in the range just north of Mount Stewart, in the Parish of Goollooenboin, and in a creek falling into Main Swamp, between Portion 70 and the "Gap" in the Main Dividing Range in the Parish of Clandulla.

The Upper Marine beds form the surface over most of the low-lying land in the Capertee Valley.

Fresh Water Coal-Measures.—The base of the Fresh-water Coal Measures in the Western Coal-field has been fixed by Prof. T. W. E. David at the level of, and including a bed of coarse gritty conglomerate, named by him "Marangaroo Conglomerate," because of its development in the vicinity of Marangaroo. This bed appears to be chiefly developed along the south-western margin of the Coal Measures between Lithgow and Capertee. It forms a marked escarpment along the southern fall into the Capertee Valley. Where it appears as the surface rock, the ground is covered with rounded white quartz-pebbles. The arenaceous and quartz-pebbly character of this conglomerate readily distinguishes it from the mudstone and quartzitic boulders and pebbles of the Upper Marine Group upon which it rests conformably.

Above this conglomerate are the shales and fine-grained sandstone beds which form the actual coal-bearing horizon of the Permo-Carboniferous formation in the Western Coal-field.

The shales are marked in places by conspicuous cherty bands, and thin layers of ironstone—the so-called "clay band" ore of the above coal-field. The iron-ore has a peculiar concretionary and prismatic structure, no doubt due to the infiltration of iron salts into joints and shrinkage cracks resulting in a thin shell of ferric oxide enclosing a clayey kernel.

The shales are highly fossiliferous, the characteristic forms of the Australian Permo-Carboniferous flora, *Glossopteris*, *Vertebraria*, and *Phyllotheca*—being present in great abundance.

The coal-bearing beds of this region are believed to be identical with the Newcastle division of the Permo-Carboniferous Formation. They are confined to the elevated areas forming the table-lands, ranges, and isolated mountains; and their

highest limit is clearly defined by the commencement of the slope into the valleys directly beneath the precipitous sandstone escarpment. Their lower termination in the valleys, or rather on the slopes, is generally well marked by the absence of a loose shaley material, and the beginning of the characteristic yellowish clayey soil, with loose boulders and pebbles, formed from the weathering of the underlying Upper Marine beds.

The following section of the coal seams in the Lithgow Valley Coal-field, measured by Mr. J. Mackenzie, F.G.S., Examiner of Coal-fields, in the Lithgow Valley Coal Shaft, will serve as a guide to the area under description, as the coal seams in question extend into it in the same relative positions, but with varying thicknesses:—

ft.	in.	
10	0	Alluvium.
20	0	Sandstone.
4	0	Coal.
20	0	Sandstone.
13	6	Coal with a number of clay bands.
159	0	Shales, sandstones, &c.
1	0	Coal.
7	6	Shale and fireclay.
5	0	Fireclay.
1	0	Coal.
37	6	Friable shale with ironstone bands.
32	4	Sandstone and shale.
0	7	Coal.
4	0	Indurated clay full of *Vertebraria.*
10	0	Grey sandstone and conglomerate with coal pipes.
10	6	Coal with bands (Lower Lithgow seam).

The lowest coal seam—which is given in detail in Mr. Mackenzie's section—is the one worked in the Lithgow Valley Collieries.

As stated above, these seams extend into the area in question, and will doubtless have a value there in the future which they do not now possess. The special importance attaching to these seams at the present time is the occurrence in them of numerous and wide spread patches of petroleum oil cannel coal (Kerosene Shale). Though the known deposits in and near the Capertee Valley are of a lower average quality than those of Hartley and Joadja, yet in view of the anticipated early exhaustion of the latter, they must ere long come into prominence. It is indeed probable that the chief supply of shale will in the future be drawn from this and neighbouring localities to the north and east.

The principal shale mine, and the only one as yet from which the product is being sent to market, is the Genowlan Shale Company's, in the Parish of Airley, about seven miles north of Capertee Railway Station. The following section of the seam in the working tunnel was measured by Mr. E. F. Pittman, Government Geologist, &c.:—

ft.	in.	
1	8	First quality kerosene shale.
0	3	Splint coal.
0	5	Second quality kerosene shale.
0	6	Inferior bottom shale (discarded).
0	6	Fine-grained sandstone.
0	2	Ironstone band (carbonate of iron).
0	4	Bituminous coal.

The seam has an excellent roof and floor, and is worked by undercutting in the six-inch sandstone band, which yields readily to the pick. The shale, being very jointed, is easily broken down without explosives.

The six-inch bottom shale is at present discarded because of its inferiority as compared with the upper portion of the seam.

In the adjoining lease on the north, Foster and Party are driving a tunnel in the same seam.

The gap, through which the Genowlan Company's road passes to the surveyed Glen Alice and Capertee Road, divides the elevated coal-bearing tract in the Parish of Airley from a similar but larger area in the adjoining Parish of Morundurey. The northernmost extension of the latter is known as Genowlan, and the easternmost as Morundurey Mountain. The mineral leases in force cover the whole of the productive measures in both parishes. Across the gully from the Genowlan Company's tunnel the shale seam is stated to have been traced into the Genowlan Mountain; but prospecting operations are not at present being carried on.

In an ascent of the range forming the eastern boundary of the Parish of Gollooenboin, County Cook, and near Mount Stewart, on a line bearing about south-south-east from Genowlan Mountain, the perished outcrops of three coal seams were noted, one of which carried undoubted decomposing shale. From barometric measurement the latter corresponds with the Genowlan Company's seam. No prospecting has been done at this point.

The next most important deposit is in Corbett's Lease, M.L. 20, Parish of Gindantherie, County Cook. The seam occurs on the south side of the narrow gorge—locally known as "The Gully"—through which the Capertee River flows east of Glen Alice, at about twenty-three miles from Capertee Railway Station.

A tunnel has been driven into the seam for about eighty feet, but, for some unaccountable reason, not at right angles to the outcrop. The shale for the first half at least of the distance averages two feet in thickness without bands, but it has thinned at the faces to about one foot three inches. The following is the analysis of a sample selected by myself:—

Hygroscopic moisture	00·65
Volatile hydrocarbons, &c.	68·40
Fixed carbon	11·50
Ash	19·45
	100·00
Specific gravity	1·168
Sulphur	1·304 %

In the same parish the shale has been proved by Mr. I. Wall about three and a quarter miles to the south-east on the northern fall into the Wolgan River, north of Portion 25, in the Parish of Barton, County Cook. It has also been proved about four and a half miles to the south-west by Mr. C. Knoblanche, south of Portion 9, in the Parish of Gindantherie.

The occurrence of Kerosene Shale in the localities mentioned, viz., Corbett's Lease, Messrs. Wall and Knoblanche's discoveries, and near Mount Stewart—previously described—practically proves its persistence under the whole of the table-land in the Parish of Gindantherie, between the Capertee and Wolgan Rivers, though with what degree of uniformity of grade prospecting alone can show. In view of the above provings, the whole of the land in the parish mentioned has been recommended as a mining reserve. It may perhaps be added that it is practically worthless for any other purpose.

The Wondo Shale Mine, situated about one mile from Glen Alice Homestead, on the north-west, at the end of a high range trending west, is at present being re-opened under the management of Mr. Inch. Trial shipments are being obtained from an old tunnel in the east end of the range. The following is a section measured at the face of the working:—

2 in. Clay.
8 in. First quality shale (see analysis).
8 in. Inferior splint.
6 in. Second quality shale.
2 in. Coal.

The top eight inches of shale is the only portion of the seam at present being prepared for shipment. The following analysis of a sample selected will reveal its quality, the low percentage of ash being remarkable for the shale of this district:—

Hygroscopic moisture	00·25
Volatile hydrocarbons, &c.	75·55
Fixed carbon	15·85
Ash	8·35
	100·00

Specific gravity	1·072
Sulphur	0·642 %

I was informed by Mr. Inch that an analysis showing 85 per cent. of volatile matter has been made from the seam. The extension of prospecting operations in the leases under Mr. Inch's management may reveal a thickening of the top band of shale, or an improvement in the lower portion of the seam; otherwise it is questionable whether such a thin marketable portion will pay to work, especially in view of the twenty three miles cartage by teams.

At Mount Marsden, in the Parish of Clandulla, near Bogie Station, a tunnel was driven some time since in what is known as Morrison's Old Lease (now Campbell's). About eleven feet nine inches of coal and bands are exposed, and judging from the lumps at the tunnel mouth a shale seam a few inches thick occurs in it; but from the weathering and soakage in the sides of the tunnel, I was not able to distinguish it from the coaly material. An analysis of a sample selected from the surface heap gave the following results:—

Hygroscopic moisture	2·55
Volatile hydrocarbons, &c.	57·60
Fixed carbon	22·70
Ash	17·50
	100·00

Specific gravity	1·239
Sulphur	0·686 %

A section of the entire seam exposed in the tunnel was measured approximately, as follows :—

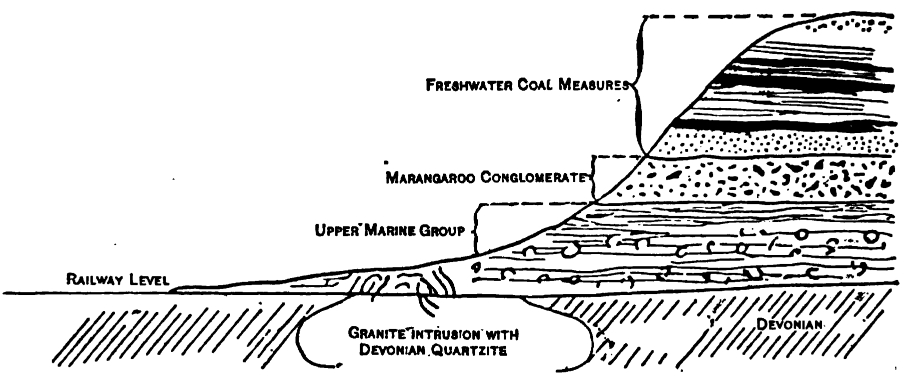
ft.	in.	
1	3	Coal.
0	1½	Band.
1	0	Coal.
1	0	Band.
2	0	Coal.
0	3	Band.
2	0	Coal.
0	1½	Band.
4	0	Coal (to floor of tunnel).

On the eastern slope of the main dividing range near "The Gap," due west of Mount Marsden, loose fragments of shale were found, though the seam was not discovered *in situ* owing to the heavy covering of alluvial and *débris*, and the absence of any extensive drainage erosion. The perished outcrops of two small coal-seams were, however, noted.

Though, as before stated, no description was contemplated of any of the land under examination embraced by the Geological Map of Hartley, Bowenfells, Wallerawang, and Rydal, yet in view of the subsequent prospecting of the shale seams at Marangaroo noted thereon, it will perhaps be advisable to add the results of a recent examination made in connection with Mr. E. F. Pittman.

The coal and shale seams occur just north of the Marangaroo Railway Tunnel, and have been prospected to a considerable extent by trenching on the outcrop of the lowest seams, and by two tunnels in the upper seams on the east face of ridge and one on the west, though work is not at present being continued.

The following sketch section showing the sequence of strata from the commencement of the Marangaroo Tunnel on the east side of the ridge may prove of interest :—



The main tunnel in the upper shale-bearing seam exposes the following section, measured by Mr. E. F. Pittman:—

Sandstone roof.

ft.	in.	
0	7	Coal.
0	2	Inferior shale.
0	6	Coaly-shale.
0	5	Second class shale.
0	9	Inferior shale.
1	5	Coaly-shale.
0	3	Second class shale.
0	4	Clay-shale.
1	0	Coaly-shale and bands.

A second section in a tunnel near by was measured with the following result:—

ft.	in.	
0	9	Dirty coal.
0	5	Inferior shale.
0	5½	Dirty coal.
0	1	Clay band.
1	2	Coal and bands.
0	10	Inferior shale.

About five feet above the main tunnel a small opening has been made in the top coal seam exposed in the ridge.

The most recent prospecting is a tunnel on the western fall of the ridge, exposing a seam giving the accompanying measurements:—

ft.	in.	
1	0	Bands of shale and shale bands.
0	3	Clay band.
1	7	to 2 ft. Kerosene shale—inferior—(No. 1 sample).
0	0½	Clay band.
1	0	Kerosene shale—inferior—(No. 2 sample).

The analyses of the samples selected from the two bands of shale are very disappointing as will be seen from the results here given:—

	No. 1 sample.	No. 2 sample.
Hygroscopic moisture	2·74	2·03
Volatile hydrocarbons, etc.	36·64	28·84
Fixed carbon	8·28	10·89
Ash	52·34	58·24
	100·00	100·00

In connection with the occurrence of petroleum oil cannel coal, or kerosene shale, there appears to be a prevailing opinion amongst the miners engaged in working it, that a seam will pinch under a heavy covering; in other words, when the workings extend beyond the sloping country on the side of a valley into and beneath the high sandstone cap of the mountain, ridge, or tableland, the shale will

thin out. However much past workings may appear to support this view, there can be no real ground for such a belief, inasmuch as the one time extension of the heavy sandstone covering over all the intervening valleys, must be apparent to even the most casual observer of the corresponding features presented by similar horizons in opposite mountain faces. The present surface configuration being due to denudation long subsequent to the deposition of the strata containing the shale and the material forming it, the comparatively recent removal of a portion of the overburden could have had no conceivable effect upon the thickness of the seam.

Hawkesbury Series.—The sandstone beds which form the summits of the elevated areas in the Capertee Valley District, and which present vertical cliff faces to the valleys, are the lowest beds of the Hawkesbury (Triassic) Series, and should, perhaps be termed "Narrabeen" beds, in strict accordance with the latest division of the series into—

$$\text{Hawkesbury Series}\begin{cases}\text{Wianamatta Shales.}\\ \text{Hawkesbury Sandstone.}\\ \text{Narrabeen beds.}\end{cases}$$

Probably a detailed examination may reveal thin cappings of the Hawkesbury Sandstone proper on points of extreme elevation.

The Narrabeen beds are characteristically developed at Narrabeen, near Manly, from which they derive their name. Here the beds are of considerable thickness, though probably thinner than at Cremorne Point, Port Jackson, where a thickness of 1896 feet 6 inches is recorded in the diamond drill bore recently put down.*

The Narrabeen rocks at Cremorne consist chiefly of chocolate shales with greenish-grey and white sandstones and beds of tuffaceous material, but in the Western Coal-field beyond Lithgow the arenaceous beds predominate almost to the exclusion of the argillaceous.

Eruptive Rocks.—In only one instance was an eruptive rock, of more recent date than the Freshwater Coal Measures, observed in the area examined.

In the railway cuttings south of Ben Bullen, between the 119 and 191¾ mile pegs, granite is seen forcing up with it on either side rocks of Devonian age—the latter showing considerable alteration by the contact. For some distance the marine beds are filled with large boulders and fragments of the granite.

In the road cutting in the Genowlan Gap an apparently small basaltic dyke is revealed, and rendered noticeable by the porcellanised condition and prismatic form imparted to the clay shales on the line of contact. The occurrence of basalt on the top of Airley and Genowlan Mountains has been recorded by Mr. Mining Surveyor Seaver in his report on Kerosene Shale at Capertee.†

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* *Vide* Notes on the Cremorne Bore, by Prof. T. W. E. David, B.A., F.G.S., and Mr. E. F. Pittman, A.R.S.M.—*Journ. R. Soc. N. S. Wales for* 1893 [1894], XXVII, p. 443.
† Ann. Rept. Dept. Mines N. S. Wales for 1883 [1884], p. 28.

III.—Palæontology.

Devonian (*Marine*).—Mr. R. Etheridge, Junr., Palæontologist to the Geological Survey, has identified the following forms amongst the fossils collected in the Devonian rocks about three hundred yards south-east of D. M. M'Lean's Homestead on Portion 60, Parish Goollooenboin, County Cook:

Spirifera disjuncta, *J. de C. Sby.*
Nuculana sp. (of a Carboniferous facies).
Bivalves (too indistinct for determination).

From the Limestone Bluff, known as "Blue Rock," near Mt. Stewart, in the same parish:—

Syringopora, 2 sps.
Stromatopora.
Amphipora.
Athyris.

Permo-Carboniferous (*Upper Marine Group*).—From about thirty chains west of the north-west corner of Portion 80, Parish Goollooenboin.

Martiniopsis subradiata, *G. B. Sby.*
Spirifera vespertilio, *G. B. Sby.*
Goniatites or Bellerophon.
Fenestella.
Mæonia (small species).
Small bivalves (difficult of determination).

The occurrence of Upper Marine fossils *in situ* was noted in Portion 71 of the same parish, on the road to Glen Alice.

The following note by the Palæontologist is worthy of attention:—"A very interesting fact is foreshadowed by this small collection. At M'Lean's Homestead *Spirifera disjuncta* occurs in a decomposed rock. In New South Wales this species is confined, so far as we know, to the Upper Devonian, but in Victoria occurs in the Middle Devonian (Buchan Limestone). It is but reasonable, therefore, to regard the M'Lean Homestead beds as referable to one of these two horizons. Interbedded with this deposit, Mr. Carne states, is the blue limestone containing corals, akin, although I do not at present say identical, with species occurring in the thick Cave Limestones. If we provisionally retain these beds as Upper Devonian, from the known range of *Spirifera disjuncta* with us, we have presented the interesting fact of the occurrence of coral limestone in them, a point that I, for one, was not previously acquainted with. Good results would probably be obtained by a further search at these places."

XII.—On the Occurrence of an *Oleandridium* in the Hawkesbury Sandstone Series: by R. ETHERIDGE, Junr., Palæontologist and Librarian.

[Plate VIII.]

I.—Introduction.

THE present addition to the Hawkesbury Sandstone Flora is known from two localities, occurring at both under similar geological conditions. The leaves, about to be described, are provisionally referred to *Oleandridium*, Schimper, from their shape and distinctly petiolate nature, for the fructification, on which Schimper appears to have chiefly diagnosed his genus, has not been observed.

The first specimens were collected by Mr. C. Cullen, Collector to the Geological Survey of New South Wales, at the Railway Ballast Quarry, Gosford, the locality that has yielded fish remains so plentifully, described by Mr. A. S. Woodward. The leaves were next obtained by Mr. B. Dunstan at Freshwater, near Manly, and he has been kind enough to present specimens to the Departmental Collection. In both instances the leaves occur in a bed of shale, intercalated in the Hawkesbury Sandstone, certainly in one case, and probably so in the other.

II.—Specific Description.

OLEANDRIDIUM LENTRICULIFORME, *sp. nov.*

Pl. VIII, Figs. 1–3.

Sp. Char.—Leaves simple, elongately lanceolate, or boat-shaped, broad in the centre, attenuating both towards the apex and base, petiolate, and apparently more or less coriaceous; apex obtuse to a variable degree, but never acute; petiole long and strong; margins entire, and not waved, gently curved from base to apex; midrib broad and strong near the base, rapidly decreasing upwards to a fine vein; secondary veins rather variable in number in a given space, but generally about three in the space of one millimetre, issuing from the midrib at an oblique angle, but without any change in the direction of their course; seldom dichotomous, but when so once only, and then near the midrib.

Obs.—The only variability I have noticed consists in that of the width of the leaf, as compared with its length, and in the degree of obtuseness of the apex. As regards the first point extremes may be seen in Pl. VIII, Figs. 1–3; and as to the second Figs. 1 and 3 afford a good illustration, for the apex of Fig. 2 is incomplete, and would, if perfect, be narrower, and not so rounded. The largest specimen seen (Pl. VIII, Fig. 1) is five and three-quarter inches long, by one inch wide at the centre of the leaf. The smallest perfect leaf observed (Pl. VIII, Fig. 3) is three inches long by half an inch wide.

The lanceolate or almost boat-shaped form is a very characteristic feature, and seems to vary but little amongst a large number of specimens, the more club-shaped outline of Fig. 2 arising from a cause before explained. The margins are always entire, and never waved. The petiole is also another important feature in *O. lentriculiforme*, its length assisting to impart the peculiarly graceful outline characteristic of these leaves. In one instance (Pl. VIII, Fig. 2) the petiole amounts to one-third the entire length of the leaf. The midrib, although gradually tapering to the apex as a very thin vein, is quite persistent. The nervation appears to be characteristic of the species, especially as regards another plant to be noticed hereafter. The secondary veins do not issue from the midrib at an acute angle and then break off into the horizontal, but on the contrary, they leave the midrib at an acute angle and continue in the same direction to the margins. Few of them appear to be furcate, but when so dichotomy appears here and there at irregular intervals. The bifurcation may take place near the midrib, it usually does so in fact, but instances have been noticed where it occurs near the centre of each wing of the leaf. So far as observation has gone the bifurcation is unifurcate in respective veins.

We may now compare the leaves of *O. lentriculiforme* with those of some of its allies.

Oleandridium vittatum, Brong., sp.,* possesses a much longer and more slender leaf, with a widely separated secondary neuration. The latter agrees, however, with the veins in the present form, in being sparsely furcate. Feistmantel's figures† of *O. vittatum* illustrate the long very broadly strap-shaped outline of its leaf even better than Brongniart's, and also the irregularity of the furcation. Another European species, *O. tenuinerve*, Brauns, sp.,‡ bears a general resemblance to the Australian, but is less ovoid, and much more lingual. Nathorst's Swedish figures § of this plant exhibit an equally long, but more slender petiole. Another Swedish species, *O. obtusum*, Nathorst,‖ is distinguished by its regularly strap-shaped outline, with an emarginate obtuse apex. Were it not for the very fine lengthened petiole this would almost fall into the genus *Angiopteridium*. An equally narrow strap-shaped form is *O. Beyrichii*, Schenk,¶ also with an obtuse and emarginate apex, thus differing from our plant in precisely the same characters as *O. obtusum*.

The nearest ally of *O. lentriculiforme* with which I am acquainted is *O. stenoneuron*, Schenk.** Unfortunately Schenk's illustration is that of an imperfect leaf, but so far as its characters can be made out it appears to be a close ally of our plant.

* Hist. Foss. Veg., 1828, I, p. 263, t. 82, f. 1–4.
† Pal. Indica (Gondwana Flora), 1876, II, Pt. 1, p. 15, t. 1, 2, and 12.
‡ Schenk's Foss. Flora Grensch., 1868, Atlas, t. 25, f. 3 and 4.
§ Floran vid Bjuf., 1878, I, Pt. 1, t. 7, f. 6.
‖ *Ibid*, t. 8, f. 7, 9, 10, 13.
¶ Beiträge Flora Vorwelt, Heft 4, t. 8, f. 6–7*a*.
** Foss. Flora Grensch., 1868, Atlas, t. 25, f. 5 and 6.

The outline and neuration of *O. lentriculiforme* will serve to distinguish it from the Australian *Tæniopteris Carruthersi*, Ten. Woods,* but until the base of the latter is known, to say nothing of its fructification, it will be impossible to place it correctly in its genus. Notwithstanding that numerous figures of the leaves of this plant have been published by Feistmantel and others, no complete illustration has appeared, so far as I know; nor am I acquainted with a perfect example in collections. It is always represented as a broad-linear, more or less parallel-sided, long, *Angiopteridium*-like leaf, with the secondary veins constantly furcate near the mid-rib, arising from the latter at a very acute angle, and then directed outwards towards the margin, at an oblique, although less acute angle. These veins are seldom horizontal, as stated both by Tenison Woods and O. Feistmantel. This fact is apparent both in the original figure of Mr. Carruthers and in Dr. Feistmantel's. Under these circumstances I can but regard the two Australian plants as distinct.

Loc. and Horizon.—The specimens obtained by Mr. Cullen are from a bed of shale in the Railway Ballast Quarry near the Gosford Station on the Northern Railway. The fossiliferous shale lies near the base of the section as then exposed, but at the top of a group of flaggy hard sandstones. The section revealed by the neighbouring Ourimbah bore "renders it doubtful whether the bed belongs to the lower portion of the Hawkesbury Sandstone or to the upper portion of the Narrabeen Shales,"† conformable members of our Triassic System.

Mr. Dunstan's examples of *O. lentriculiforme* were obtained in shale and shaly-sandstone at Freshwater, about one mile and a quarter miles north of Manly, "being the second point on the coast-line north of Manly Ocean Beach."‡ This horizon is in the Hawkesbury Sandstone.

XIII.—Notes on the Occurrence of Diamonds at Bingera (Bingara): by G. A. STONIER, F.G.S., Geological Surveyor.

A REPORT of the discovery of a supposed volcanic pipe on the Melbourne and Bingera Diamond Mining Company's property has recently afforded an opportunity for an examination of the latest developments in some of the Bingera deposits. The latter have been known for a number of years to be diamantiferous, and have been reported upon officially by—

(1.) E. F. Pittman, Ann. Rept. Dept. Mines N. S. Wales for 1881 (1882), p. 141.

* Proc. Linn. Soc. N. S. Wales, 1883, VIII, p. 117.
† David, Mem. Geol. Survey N. S. Wales, Pal. Series, No. 4, 1890, p. viii.
‡ Dunstan, Journ. R. Soc. N. S. Wales for 1893 [1894], XXVII, p. 378.

(2.) C. S. Wilkinson, Ann. Rept. Dept. Mines N. S. Wales for 1886 (1887), p. 89.

(3.) W. Anderson, Ann. Rept. Dept. Mines N. S. Wales for 1887 (1888), p. 156.

These reports, as well as two on N. S. Wales diamonds* and Professor Liversidge's work,† have been freely used in the preparation of the following notes.

The deposits which have many characteristics in common with, but are, nevertheless, distinct from the Cope's Creek (Inverell, N.S.W.) drifts, are auriferous as well as diamantiferous, and are developed chiefly within an equilateral-triangular area of three square miles in the Parishes of Bingera and Derra Derra, County Murchison, about five miles west-south-west from the township of Bingera, and two hundred and eighty miles from Sydney in a direction a few degrees west of north. Bingera is situated on the Gwydir (or Big) River, which is a main stream in the north-western fall of the Colony, and flows in a north-westerly direction for six miles below the township, where it receives, as a tributary, the Horton (in the early days known as the Big) River, which latter branches off in a southerly direction. A well-marked range 1,200 to 1,400 feet above Bingera divides the waters of the streams above their junction; the water-parting is sharply defined in places, but near the diamond mines the range is flat-topped, having a width of nearly two miles, and breaking off precipitously on each side; the mines are situated on the north-eastern fall and close to the range, which, with a spur, encloses them somewhat in the form of a horse-shoe.

The deposits consist of gravels and sands of Tertiary age (with unimportant Pleistocene and Recent redistributions) now occurring chiefly, as far as has been proved, as outliers in ridgey country about five hundred feet above the main water-courses; for the most part they are loose and easily mined, but in places becoming compact with occasionally thin beds of a hard ferruginous quartz conglomerate; some are undoubtedly of fluviatile origin, but it is not clear that other portions are not littoral deposits. Several instances occur on the field where there appears to be neither outlet nor inlet for the drift—they may possibly represent deep waterholes in the old channels.

The pebbles contained in the gravels are waterworn, subangular, and angular, the majority being well rounded; they vary in size from a half to six inches, averaging about two inches with occasional boulders up to two feet in diameter, and are composed chiefly of a red jasperoid claystone, jasper, and black siliceous mudstone with quartz of various kinds, felspathic quartzite, pale greenish grey siliceous shale, altered claystone, and other altered sedimentary rocks, rarely a felspar porphyry, a variety of small gemstones and minerals and stiff whitish-grey clay boulders, the proportion of the different rocks varying in each separate deposit.

* Etheridge, Junr., and Davies, Ann. Rept. Dept. Mines N. S. Wales for 1887 [1888], p. 42. L. Atkinson. *Ibid.*, p. 46.
† Minerals of N. S. Wales, 1888, p. 235.

The drifts have a maximum thickness of sixty-five feet; they cannot, however, be averaged, nor can the average thickness of the diamond-bearing portion be ascertained until the deposits are more opened out. At Craddock's Claim (M.L. 126) it is proposed to work ten feet of the drift; at M.L. 139, fifteen feet is considered to be diamantiferous; and at the Monte Christo, where only two feet six inches was taken by the previous leaseholders, Captain Rogers has opened two drives, showing four, and from four to nine feet respectively of wash-dirt, from a shaft thirty-six feet deep in a portion of the ground previously untested. The diamantiferous wash, not including that which is covered by basalt and not yet tested, covers a superficial area of about two hundred acres, and although in the rich patches diamonds are plentiful and astonishing prospects can be obtained, it is exceptional for a large body of wash to contain an average of more than one to one and a half carats to the load, and much of the drift will not yield a carat to the load. In some of the claims the gems are fairly distributed, but in others they are confined to layers about nine inches thick, separated by a variable and inconstant amount of drift which is absolutely valueless. In one instance five of these layers occur in a face of seven feet of drift. The layers cannot be relied upon for even a few feet, but may cut out unexpectedly, and, when close to a sidling, have been found to rise with the bed-rock, until, instead of being horizontal, they have acquired a steep dip. The diamonds are found to be accompanied almost invariably by small fragmentary gemstones (sapphires, zircons, &c.) and well-worn "pencil" tourmalines; as a rule "morlops," small rounded siliceous pebbles with an exceptionally high degree of polish and composed of black siliceous mudstone and jasper of various colours, are also present.

The diamonds are small and average five to the carat (the average varies on different parts of the field from three to seven) running up to twenty to the carat, with not more than one per cent. of carat stones in a general parcel, and in some cases five per cent. of three-quarter carat and ten per cent. of half carat stones; the largest yet found was considered to be three and a-half carats, but actually weighed two and one-eighth carats—it was flawed and not of value. At Inverell larger stones are found than at Bingera; one was obtained which weighed seven and a-half carats.* As a rule more than fifty per cent. are straw-coloured, and of the diamonds exhibited at the Indian and Colonial Exhibition in 1886, thirty-three per cent. were colourless with one per cent. of "rejections." They are harder than the Cape gems and hence take longer to polish, but in brilliancy and refractive power the New South Wales stones surpass the African, and one cut in London in 1886 is stated to have been as fine a brilliant as it was possible to obtain from any part of the world. About one per cent. of the stones are found almost perfectly crystallised with flat facets, the remainder having curved, rounded, and fractured (eight per cent?) faces often pitted, and it would appear possible that

* C. S. Wilkinson, Ann. Rept. Dept. Mines N. S. Wales for 1887 (1888) p. 43.

a small percentage are travelled fragments of gems much larger than any yet found in the deposits themselves. Mr. R. Etheridge, Junr., states that the Inverell gems which he carefully examined in London were all crystallised and that none of the faces were abraded.

The gold on the western portion of the field is fine and flaky, with fine specks somewhat cubical in shape and sometimes coated with "rust," and occasionally quartz specimens; it is said to be worth £4 2s. per ounce. Well-worn pieces of six and seven dwts. occur in the eastern drifts, and have a value of £3 14s. per ounce. Payable gold has not been discovered in the drifts themselves; several recent re-distributions of the diamantiferous wash have paid wages in the past but are now worked out. Platinum (? Osmiridium) is also found, but not in sufficient quantity to encourage any attempt to save it.

The diamantiferous wash rests upon a series of sands, clays, and ironstones, with occasionally thin layers of wash; the formation is fossiliferous, and has yielded a small *Unio* allied to *Unio Wilkinsoni*, Eth. fil., the seeds *Plesiocapparis leptocelyphis* and *Phymatocaryon Mackayi*, F.v.M.,* and various leaves not yet determined. The clays, &c., occupy a large area, and have a maximum thickness of nearly four hundred feet, but as they were subjected to considerable denudation prior to the deposition of the diamantiferous wash, and the bed-rock also shows evidence of deep erosion, the thickness is very variable. To the south and west of the diamantiferous outliers, the clays are overlaid by basalt of which there are two distinct sheets separated by one hundred to a hundred and twenty feet of fine gem sand with thin beds of clay and gravel, which is said to have yielded several small diamonds. The lower basalt has a maximum thickness of three hundred feet averaging about one hundred and fifty feet, and varies in width from a few hundred yards to nearly two miles, extending in a north-westerly direction for nine miles; the upper sheet has a maximum thickness of three hundred and fifty feet, and has been denuded into large outliers. It is probable that the diamantiferous wash extends under the lower sheet of basalt, but independent of that wash and necessarily of an earlier geological age, a lead has been proved to exist between the clays and the bed-rock, and there is every reason to believe, from the occurrence of a high ridge forming probably one of the sidlings of an old channel, that it runs for a considerable distance. So far as can be ascertained the wash was perfectly barren where it was struck, but as the work is confined to two shafts, further prospecting operations are very necessary. In one of the shafts referred to a large body of wash was struck, consisting chiefly of pale greenish-grey laminated quartzite, altered mudstone, and siliceous sandstone, fairly well rounded and up to eight inches in diameter. The other shaft struck a thin layer of a fine well-worn quartz wash.

* R. Etheridge, Junr., Ann. Rept. Dept. Mines and Agric. N. S. Wales for 1891 [1892], p. 268.

The bed-rock contains *Lepidodendron australe*, McCoy, and various marine shells not yet examined; it consists of thin bedded mudstones, sandstones, and occasionally conglomerates, argillaceous and oolitic limestones and quartzites; hard, thick-bedded, in some places massive, gritty tuffaceous and calcareous mudstones and sandstones passing into volcanic tuffs, and breccias with interbedded porphyrite (?). They are traversed by a number of veins of quartz and calcite (in places auriferous), and a few felspathic, somewhat brecciated, lodes, and are intersected by dykes of diorite, and occasionally basalt (?), and masses of felspar-porphyry, and, to the east and south of the township of Bingera, by serpentine and a coarse ternary tourmaline granite. These rocks will be more fully described on completion of the microscopic slides.

The future of the diamond industry at Bingera depends largely upon the discovery of a matrix, and the exploitation of the basalt range. That the deposits in which the diamond occur are totally dissimilar to the Kimberley pipes there has never been the least reason to doubt, but the question as to whether the diamonds have not been derived from a formation which bears some resemblance to that of the Kimberley pipes is still unsettled. That the diamonds were formed in the drifts is held by several writers on the subject, and the late Mr. Norman Taylor* considered that at Cudgegong, in the Western District of N. S. Wales, where there are drifts of two ages, the diamonds were formed in the older and distributed into the more recent drift. The late Mr. C. S. Wilkinson held the same view at one time, but after an extended examination of the various diamond deposits in the Northern District he suggested that "if the Tertiary drifts be not the original matrix of the diamond, possibly its source may be in the metamorphosed Carboniferous or Devonian beds, where they have been intruded by granite and porphyry"†. Prof. T. W. E. David, whom the Author of this paper accompanied on a visit to the Cope's Creek diamond mines in 1891, came to the conclusion that the Cope's Creek (*i.e.*, Malacca, Round Mt., &c.) diamonds were probably derived from the tourmaline granite.

At Bingera there are two drifts, but the older drift has not been found up to the present time to contain diamonds, and it does not appear to be at all probable that the gems have been formed *in situ*; as, however, they are found in a pipe of picrite-porphyry (Stelzner) at Kimberley, and altered peridotites occur in New South Wales, why should not a pipe have been formed in this country also? The occurrence of a pipe mass on the diamond field at Mittagong, New South Wales, has been already noted by the late Mr. C. S. Wilkinson‡, and it would appear likely that prospecting operations will prove that this "pipe-dyke" mass contains diamonds. So far as my observations have extended, the volcanic breccias of the

* Geol. Mag., 1879, VI, p. 457.
† Ann. Rept. Dept. Mines N. S. Wales for 1887 [1888], p. 137.
‡ Ann. Rept. Dept. Mines N. S. Wales for 1890 [1891], p. 210.

Bingera district, already observed, belong to a series of contemporaneous submarine tuffs interbedded with sediments of probably Carboniferous age. Hitherto, so far as can be ascertained, no definite trace of volcanic breccias of later age have been observed in the district, although it is of course highly probable that rocks of that description may occur in the neighbourhood of the original sources from which the basalts covering the diamantiferous gravels flowed. It is obviously impossible, however, that the diamonds in the drifts could have been derived from any volcanic pipe of later age than the diamond-bearing gravels, and as the basalt is younger than the gravels, the diamonds must probably have been formed from plutonic action in some eruptive rock older than the basalts overlying the diamond drifts. Of these there are two varieties—

1. Serpentine.
2. Tourmaline granite.

That the serpentine (an altered peridotite) was formed earlier than the diamond drift, and therefore may have been the source of the diamonds, is rendered probable by the presence of numerous pebbles of red jasper in the diamantiferous gravels, the jaspers having been chiefly formed by the intrusion of the serpentine into the Carboniferous sedimentary rocks. This serpentine belt can be traced almost without a break from Attunga, near Tamworth, to within a few miles of Warialda, a distance of ninety miles; jaspers are found, sometimes in large masses, for nearly the whole distance at the junction of the serpentine with the sedimentary rocks.

That the tourmaline granite is older than the diamantiferous gravels is obvious from the amount of detrital material derived from it, and found in the diamantiferous gravels at Cope's Creek, near Inverell.

There are also possible sources in the Carboniferous tuffs—there can be no doubt that they are older than the gravels—and in basalts somewhat older than the diamantiferous gravels, but of the existence of such basalts no evidence has yet been obtained.

The question is by no means settled, and although there would appear to be no reason why one of the sources should not be found near Bingera, the recent work on M. Ls. 9, 47, and 134 (the property of the Melbourne and Bingera Diamond Mining Company) has failed to disclose it.

XIV.—The Idiographic Carvings at Cockle Creek, Cowan: by R. ETHERIDGE, Junr., Palæontologist and Librarian.

[Plate IX.]

I.—Introduction.

MY first acquaintance with these carvings arose from a brief note and sketch by Mr. R. Dalrymple Hay, of the Crown Lands Department, and Forest Ranger, published in the "Surveyor."* Mr. Hay was kind enough to conduct Mr. G. H. Barrow and myself to the locality.

These carvings are without doubt the most interesting that have yet come under my notice, for amongst them are portrayed the figures of the woman and the Emu, objects that played no insignificant part in the mythology of our east coast Blacks, as I hope to show in the sequel. Not only do these possess this important bearing, but even the posture of the male figures is suggestive of those assumed by the wizards in some of the ceremonial magic dances performed during the *Bora* ceremony.

II.—Locality.

The carvings occur on the rounded table of sandstone usually selected as an appropriate site at a place called Bobbin, close to which runs the old track. The sandstone table is immediately at the head of a gully running into the left-hand branch of the head waters of Cowan Creek, and known as Cockle Creek, in the Parish of Gordon, Co. Cumberland. The table runs nearly in a north and south direction, and is so much overgrown with scrub, like the whole of the surrounding area, that, could this be cleared away, no doubt additional figures would be exposed to view. The unfrequented and retired nature of the spot has probably contributed to the excellent state of preservation of most of the carvings, and rendered their delineation comparatively easy.

III.—The Figures.

As a rule carvings of this description are clustered together, but in the present instance this is departed from, and the figures occupy an extended line, following one another in tolerably rapid succession, in the order displayed on Mr. Hay's sketch. There were at least fifteen recognisable figures at the time of our visit, the following being the most important—an imposing male figure (Pl. IX, Fig. 15), with arms raised above the head, and the legs bowed, girt with the belt of manhood, and exhibiting not only the eyes—a very unusual addition to these carvings—but also a series of radiating lines from the crown of the head, and

* The Journal of the Inst. Surveyors N. S. Wales, 1892, V, No. 3, p. 193.

with the fingers correctly represented. The figure is in all six feet two inches in height, and both as to correctness of drawing and detail is a great advance on similar representations in previously recorded cases. Lying next to this, and with one leg thrust across the man's thigh, is the undoubted figure of a woman (Pl. IX Fig. 14), also with the arms extended upwards, and the legs, instead of being gathered up under the body, extended outwards. Here again nature has been faithfully copied in that the pendulous mammæ of the female aborigine are correctly represented. This is also the case in the figure of the second woman (Pl. IX, Fig. 5). In this instance the feet are wanting and only one hand is present, whilst in the former case (Pl. IX, Fig. 14) one foot is shown. What is, however, particularly interesting in this representation, is the peculiar heart-shaped body placed above, but unconnected with the head. The female figures are respectively three feet six inches high (Pl. IX, Fig. 14) and three feet five inches (Pl. IX, Fig. 5). An imperfect outline (Pl. IX, Fig. 2) is also intended for a human figure, with the arms outstretched, and a more or less bird-like head, a repetition of one of the outlines seen at Bantry Bay.

I can offer no solution of the two globular bodies resting on the shoulders of Fig. 2. In Pl. IX, Fig. 4, is seen a well formed leg two feet long, bent at an angle not infrequently seen in some of the dances practised by the Aborigines. Fig. 3 is again an extraordinary representation, and unless it be intended for a Flying-fox (*Pteropus*), I cannot offer any other explanation. It is three and a half feet high, and the terminal prolongations, or legs, are only punctured on the surface of the rock, as if the execution of the figure had been suspended before completion.

Next to the human figures, however, the most interesting and important are the large feet (Pl. IX, Fig. 13 *a* and *b*), of which there are three on the sandstone table. Those here copied are about one foot in length, and occupy between the fore extremity of the one, and the hinder point of the other, a space of seven feet, thus leaving five feet of a stride between them. Feet are occasionally seen in pictorial drawings met with in Cave-shelters, such for instance as those on Wollombi Creek figured by Mr. P. T. Hammond,* but this is the first instance I have met with amongst Idiographic Carvings.

Figs. 6 and 8 are representations of the Emu. The largest (Pl. IX, Fig. 6) is six feet long, and the other (Pl. IX, Fig. 8) is three feet ten inches. The attitudes are different, one standing erect, with the neck outstretched, the other bending down as if in the act of feeding. Near them is placed a smaller bird (Pl. IX, Fig. 7) of irregular proportions.

Amongst the remaining delineations is probably what is meant for an Opossum (Pl. IX, Fig. 10) nearly four and a half feet long, occupying a position, as near as possible, one foot from the male and female figures, contiguous to one another (Pl. IX, Figs. 14 and 15). The tail, however, is somewhat short for this animal. Eight

* Records Geol. Survey N. S. Wales, 1892, II, Pt. 4, t. 15.

feet beyond this lies a Flying-squirrel (*Petaurus*) about two feet four inches long (Pl. IX, Fig. 9), the lines no doubt being intended to portray the membranous expansion between the limbs, and the change in colour of the fur on these "wings." The next figure in order of interest is that of an Iguana (Pl. IX, Fig. 1), seven feet three inches in length.

The smallest object (Pl. IX, Fig. 12) is probably an *Echidna*, resembling that seen at Bantry Bay, Middle Harbour,* and is not far from the same size, both being about one foot six inches long.

The last figure to be noticed (Pl. IX, Fig. 11) is unquestionably a dilly-bag, or rather basket, three feet nine inches long, the nearly circular mouth and the lines representing the "staking" and "siding" of the basket work showing this.

Three very important points are to be noticed in the study of this group of carvings, viz., the entire absence of representations of (*a*) fish, (*b*) shields, and (*c*) the kangaroo, either one or the other, and sometimes all three, having been noticed at most of the other localities.

IV.—Possible Interpretation.

In entering on this debatable portion of the subject it may not be out of place to quote a few remarks of one who, in his day, must have paid considerable attention to these carvings, as he did, indeed, to all other matters connected with the Aborigines. I refer to the late Mr. George French Angas, who says†—"Relative to these tracings or carvings upon the flat surfaces of the rocks of projecting headlands their uses or intentions are now only legendary. The natives say that 'blackfellow make them long ago,' and to convey an idea of antiquity they hold up their fingers and hands, elevate the face, shut the eyes, and say—'murrey-murrey long time ago.' They agree in stating that the tribes did not reside on these spots; assigning as a reason 'too much dibble-dibble walk about.' . . . . They also state that these places where the carvings exist were all sacred to the doctors and conjurors, and were in fact 'koradjee' or priests' ground . . . . . As the whole of these carvings represented indigenous objects, and above all the human figures in the attitudes of the corroboree dances, no other conclusion can be drawn, but that they were of native origin." In a former communication on this subject, when ascribing to Dr. A. Carroll and myself the only attempted explanation of these carvings, I had overlooked this passage of Mr. Angas', but perhaps its obscure method of publication may be pleaded in excuse. His remarks, however, based on the evidence of the early natives, that these were "kooradjee or priests' ground," is pretty conclusive on the subject. Sir Charles Nicholson‡ was of much the same opinion as to their great antiquity, for when describing carvings on the site of what is

* Records Geol. Survey N. S. Wales, 1890, II, Pt. 1, t. 2, f. 6.
† Waugh's Austr. Almanac for 1858, p. 58.
‡ Journ. Anthrop. Inst. Gt. Brit. & Ireland, 1880, IX, p. 31.

now Middle Head Battery, Port Jackson, he based his opinion on the amount of erosion undergone, depth of superincumbent soil, and growth of large trees, also that the old natives could [or would] not give an account of them.

I may remark, that in seeking for an explanation of these carvings, I have made free use of Messrs. A. W. Howitt and J. Fraser's graphic descriptions of the *Bora* ceremony, considering that it was amongst these peculiar observances, that an interpretation was to be found. In the case of the former writer, it is chiefly to the practices of the associated *Murring* that I refer, viz., to the *Wolgal* of the Upper Murray, Murrumbidgee, and Tumut Rivers; the *Ngarego* of the Maneroo Table-land; the *Theddora* of Omeo and the Mitta Mitta River; the Coast-*Murring* from Mallagoota Inlet northwards to the Shoalhaven River; and the *Wiraijuri*, Lower Murrumbidgee as far as Hay.* These five tribes, or perhaps more correctly speaking tribal groups, represent a social aggregate, namely a community bound together, in spite of diversity of class system, by ceremonies of initiation, which, although they vary slightly in different localities are yet substantially the same, and are common to all.† It is to the ceremony of the coast tribes, known as the *Kuringal* that reference is now more particularly made.

I need not repeat the arguments used in a former paper‡ on this subject, but will only add a few further remarks on the male figures supposed to represent *Daramūlŭn* or *Baiamai*, and then take up those not observed in previously recorded carvings. The position in which the male figures are represented is a very characteristic one of some of the magic dances, *i.e.* dances forming an integral part of the *Bora*, and differs from those commonly seen at ordinary corrobories, when the arms and legs are, as a rule, simply extended, and not the former raised above the head, and the latter more or less doubled up under the body. Howitt remarks§ that, amongst the associated community already referred to, at one side of the *Bunan* circle, where the initiate's tooth is knocked out, "the figure of *Daramūlŭn* is cut on some large tree, in the attitude of dancing the magic dance." By the Coast-*Murring*, the figure of this spirit-god, who presided at the *Bora*, is moulded in earth. In the pantomimic representations accompanying a portion of the ceremony the "Rock Wallabies" is performed, and in the attendant dance the "legs are kept somewhat apart, and at each jump the knees are somewhat bent. . . . . . at the same time the arms, hanging down, are swung to and fro across the body; this is the whole step and action."‖ It will be observed that here the arms are kept hanging down, but the upward gesture shown in our carvings both of man and women is that by which this community of peoples silently indicate the dreaded spirit or Great Master, *Daramūlŭn.*¶ This

* Journ. Anthrop. Inst. Gt. Brit. & Ireland, 1884, XIII, pp. 185 & 433.
† *Ibid*, p. 433.
‡ Records Geol. Survey N. S. Wales, 1893, III, Pt. 3, p. 82.
§ *Loc. cit.* p. 447.
‖ Howitt, Journ. Anthrop. Inst. Gt. Brit. and Ireland, 1884, XIII, p. 449.
¶ *Ibid*, p. 442

arm-raising also took place on the part of the *Tutnurring*, or initiates, during the corresponding ceremony, or *Jeraeil* of the neighbouring *Kurnai* Tribe, in South-east Gippsland.* The bent position of the leg is also assumed in some ordinary corrobories and was termed by the late Surveyor-General Mitchell the "corroboreo jump."† He says, speaking of the performers—"until each imperceptibly warms into the truly savage attitude of tho 'corrobory jump' . . . . . . the legs striding to the utmost . . . . . the arms raised and inclined towards tho head." Mr. R. Dawson, at ono time Chief Agent of the Australian Agricultural Company, who saw this doubling up of the legs at Port Stephens, compares‡ it very happily to the movement in the "limbs of a pasteboard harlequin when set in motion by a string." On the other hand the position of the legs, merely extended, as seen in the carvings at Bantry Bay (Middle Harbour), Flat Rocks (near Manly), Berry's Head, and in the present female figure (Pl. IX, Fig. 14) is by far the commonest one assumed in ordinary dances. It was so with the Hunter and Isis River Blacks,§ amongst the associated *Murring*, and is exhibited in the *Palti* dance, so beautifully illustrated by Angas in his magnificent work on South Australia.|| It also forms the frontispiece to the second volume of Lt.-Col. Mitchell's "Three Expeditions."

With regard to the head appendages or halo represented in the chief male figure (Pl. IX, Fig. 15), it may be intended for the head-dress of a headman (so-called "chief") only, and by analogy intended to convey an idea of the high position occupied by the prototype of the figure represented by the carving. Head-dresses of this description are not unrecorded in Aboriginal literature. Omitting the problematical drawings published by Sir G. Grey, in N. W. Australia,¶ and lately deciphered, in all probability with a great deal of truth, by the Rev. T. Mathew,** I may refer to the head-dress figured†† by the late R. B. Smyth, consisting of a framework of sticks and cockatoo feathers. This is called *Oogee*, and is used in corroboree at Cape York. Mr. W. T. Wyndham mentions that in the *Ucumble* tribe of New England, the old men in corroboree put *goora* or "glory" on their heads. This is the down of the *Mullion* or Eagle-hawk.‡‡

Now as to the huge footprints. In the *Wiraijuri* tribe, along the Murrumbidgee River, preceding the extraction of the initiate's tooth, amongst other things, "a strip of bark is taken spirally from a large tree down to the ground. This represents a path from tho sky to the earth, down which *Daramūlūn* descended."§§ My reading is that the large footprints (Pl. IX, Figs. 13 *a* and *b*) are simply an extension of this idea, and are intended to represent the footprints of *Daramūlūn*

* *Ibid*, 1885, XIV., p. 307, *footnote*.
† Three Expeds. Interior E. Australia, 1838, II, p. 5.
‡ Present State of Australia, 1830, p. 61.
§ Journ. Anthrop. Inst. Gt. Brit. and Ireland, 1878, VII, p. 255.
|| S. Australia Illustrated, 1846, Pls. 15 and 24.
¶ North-west and Western Australia, &c. 2 vols. 8vo. London, 1841.
** Journ. R. Soc. N. S. Wales for 1889 [1890], XXIII, pp. 414–417.
†† Aborigines of Victoria, 1878, I, p. 280, f. 82.
‡‡ Journ. R. Soc. N. S. Wales for 1889 [1890], XXIII, p. 38.
§§ Howitt, Journ. Anthrop. Inst. Gt. Brit. and Ireland, XIII, p. 452, *foot note*.

after he threw his tomahawk at the Emu, during the descent from the sky.* As I have elsewhere pointed out,† in a Rock-shelter in the Burragorang Valley hand-prints are depicted which the old Blacks of the vicinity informed Mr. Maurice Hayes, of Queagong, Burragorang, and my informant, were those of their Deity, made when on a visit to earth. Here we see a modified continuity of the same idea travelling inland from tribe to tribe.

There is an intimate relation between the figures of the Emus and those of the women. *Daramŭlŭn* had two wives according to the traditions of the associated peoples already referred to,‡ the "duality" *Ngalabal.* This name, according to Mr. Howitt, is derived from *ngalal*, a sinew, "in reference to the sinewy legs of the Emu, which is *Ngalabal*, and from *bal*, a dual affix." In that portion of the *Bora* ceremony, termed the Ngalabal-dance, *Daramŭlŭn's* two wives, the "duality" *Ngalabal,* "are seen to cross the bora circle, glide from the forest past the fire, and to disappear in the gloom beyond."§ This dual woman is not confined to the *Murring* association, but it is represented in the *Kurnai* Tribe; of S. E. Gippsland, by the female duality *Bŭlŭn-Baŭkan,*‖ occupying much the same position in their mythology.

Howitt remarks—"I use this word 'duality' as the only one I can think of which expresses the peculiar conception of the supernatural being 'Balum-baukan.' Two Baukans are always spoken of, but at the same time as if inseparable, and having one son, *Bulum-tut*, common to both."¶ In the *Woi-worŭng* Tribe, the dual wife, *Ngalabal*, is represented by the two wives of *Bungil* (the star Fomalhaut).** At the conclusion of the ceremonies when, after the extinction of the magic fire, the processions returned to the camp, and the outline of *Daramŭlŭn* was moulded in earth by the old men in the attitude of the magic dance, two dances took place, one to the word *Daramŭlŭn*, the other to the word *Ngalabal.*†† I have given these extracts from Mr. Howitt's graphic descriptions with the view of showing how intimately the postures assumed in our Idiographic Carvings are associated with the details of known ceremonies, and to account for the presence of the female and male figures, and that of the Emu.

The intimate connection between the figures of the woman and Emu is also demonstrated by some of the tribal food restrictions. The novices are confined to certain forms of sustenance, amongst other things they may not eat of the Emu, "for this is *Ngalabal*, the wife of *Daramŭlŭn*, and at the same time the "woman."‡‡

* *See* Records Geol. Survey N. S. Wales, 1893, III, Pt. 3, p. 85.
† Records Austr. Mus., 1893, II, No. 4.
‡ Howitt, Journ. Anthrop. Inst. Gt. Brit. and Ireland, XIII, p. 450.
§ *Ibid.*
‖ Howitt, *loc. cit.*, 1886, XV, p. 415, *foot note.*
¶ *Ibid.*
** Howitt, *loc. cit.*, 1884 XIII, p. 452.
†† Howitt, Journ. Anthrop. Inst. Gt. Brit. and Ireland, 1884, XIII, p. 452, *footnote.*
‡‡ *Ibid*, p. 456.

In at least one set of carvings, that at Bantry Bay, we have seen the outlined figure of a large tomahawk. The most distant of the associated peoples, the *Wiraijuri*, moulded this weapon as one of their representative objects in the *Bora*, and which, the initiates were informed was thrown by *Daramūlŭn* after the Emu, as he descended from on high.* As a portion of the same idea, our local Blacks, I believe, outlined the footprints of the Emu, to be seen in a few rare instances on some of the sandstone tables. These imprints are supposed to have been made when the Emu was endeavouring to escape from the Spirit-god. The *Wiraijuri* also moulded the figure of the bird itself, where it fell after the tomahawk was thrown.

This veneration for the Emu extended much further north than Port Jackson, for amongst the Hunter and Isis Rivers Blacks a naturally-bent tree was selected near the head of the recumbent prone figure, also moulded by them. On the bent tree were cut prints of the Emu's feet, and along it was carried a stuffed bird as if treading in the footmarks.†

In a similar manner to the derivation of *Ngalabal* by Howitt, Dr. John Fraser has sought to explain the word *Daramūlŭn*. In the *Kamilaroi* legends he informs us "*Dhar* seems to have a twofold aspect, and hence the *mūlŭn* in his name may be the word *bulla*, 'two.'"‡

It is, therefore, by applying the *Bora* customs of the associated *Murring*, as depicted by Howitt, that I seek to explain the introduction of the female figure, accompanied by that of the Emu, amongst these carvings, and this is supported by the fact that the former figures and those of the men are represented in the attitude of the dance, probably one of the magic dances.

Dr. Fraser's derivation of the word *Daramūlŭn* has already been given. In a later publication,§ he believes the first syllable *Dara*, or *Dhara*, to have its source in "*dara*, *dri*, a very old language root meaning to protect." According to the Rev. C. Greenway,‖ however, *Turramūlun* [:*Daramūlŭn*] means in the Kamilaroi language, "leg on one side only," "one legged." Now we know that the Kamilaroi organisation existed over a very large portion of Northern New South Wales. Can this derivation applied to *Daramūlŭn* be in any way connected with the conception of the large single leg (Pl. IX, Fig. 4) of our present carvings? It is quite unconnected with any of the other figures, and there is the bare possibility that its representation is an effort on the part of the local "doctor"-sculptor to convey the Kamilaroi conception of the dreaded spirit, as the more perfect male figures are believed by the writer to express those of the tribes further to the south, possessing *Murring*

* *Ibid*, p. 452.
† Ridley, Kamilaroi and other Austr. Languages, 1875, p. 156.
‡ Journ. R. Soc. N. S. Wales, for 1891 [1892], XXV., p. 275. In a letter kindly communicated to me by Dr. Fraser, the latter remarks: "It is clear to me that *Daramūlŭn* was a dual divinity, somewhat the same way as Castor and Pollux, and that he is the representative of *Baiamai* in the work of creation, and in communicating with men. The *Wiradhari* dialect calls him *Darawirgal*, from *Wirgal*, the tree in the form of a rainbow, which grows out of his thigh."
§ Aborigines of N. S. Wales, 1892, p. 19.
‖ Journ. Anthrop. Inst. Gt. Brit. and Ireland, 1878, VII, p. 242.

organisation. No doubt the Hawkesbury Tribes must have been influenced to some extent at least by the traditions on both sides of them, bearing in mind that the Kamilaroi cult, strictly speaking, seems to have reached its southern limit at or about Maitland on the Hunter River.*

Of the dilly-basket (Pl. IX, Fig. 11) I am not at present able to offer any explanation.

The only suggestion I am able to propose for the bird-like object (Pl. IX, Fig. 3) is that it is intended either for a Flying-fox, or an Eagle-hawk. This bird was in some tribes the representatives of a totem subdivision within one of the class systems, but the Coast-*Murring*, "had, however, with male descent lost the class divisions, and the totems only remained as magical names."† There is the possibility that it may have remained amongst our Blacks in this sense.

The Iguana (Pl. IX, Fig. 1) and the Opossum (Pl. IX, Fig. 10) were also totem names, but as so little seems to have been preserved connected with the inner organisation of the Port Jackson and neigbouring tribes, I merely throw out these remarks as suggestions. It may, however, be pointed out that Dr. J. Fraser has recently figured ‡ a tree from the upper circle of a *Bora* ground in N. S. Wales, on which the figure of a large Iguana was carved, accompanied by two male figures, one with the arms elevated.

I may, perhaps, be allowed to anticipate criticism by indicating the one weak point in the deductions I have drawn from these carvings. Lieut.-Col. Collins, in his "English Colony in N. S. Wales," the only work giving a reliable description of the *Bora* ceremonies, or any ceremonies at all, of the Port Jackson Tribes, represents them as taking place in open glades of the woods. Collins merely illustrates the more openly performed scenes in the ceremonies, and there is no internal evidence to show that he was present at all of them. In fact, from the well-known reluctance on the part of the Blacks all over the Continent, to admit the White to a participation in their mysteries, we may conclude with tolerable certainty that he was not. However, be this as it may, we have every reason to believe that as far as they go, Collins' depictions are most faithful representations of what he saw in those early days.

V.—Distribution of the Carvings.

We at present know comparatively little about the distribution of these carvings, except in our own immediate district. As the coastal area is left behind, the place of these rock-sculpturings seems to be taken by Idiographic Drawings. At the same time Ridley in describing§ the rites of the *Wailwun* Tribe, says that on one of the stony ridges between the Barwon and Narran Rivers, is a hole in the rock shaped like a man, but two or three times larger. In this the Blacks believed *Baiamai*

* Howitt, Journ. Anthrop. Inst. Gt. Brit. and Ireland, 1889, XVIII, p. 33.
† Howitt, Journ. Anthrop. Inst. Gt. Brit. Ireland, 1889, XVIII, pp. 41 and 48.
‡ Aborigines of N. S. Wales, 1892, p. 16, 3rd plate.
§ Kamilaroi and other Austr. Languages, 1875, p 136.

used to rest himself, during his visits on earth. Mr. W. A. Cuneo, of Thirlmere, has lately discovered carvings in the Burragorang Valley, at Apple Grove, on the flat surface of a rock of the Permo-Carboniferous System. They consist of the figures of a fish and the Emu. If it be ultimately shown that these carvings are in a great measure confined to what may be called the Hawkesbury Basin, using this term in its most extended sense, the occurrence of them further inland, throughout the eastern portions of New South Wales, may perhaps be accounted for by what Mr. Howitt has well expressed by the term "by attendance," * *i.e.*, the presence of those members of other tribes who were privileged, either by blood relationship, or knowledge of the mysteries in practice. Many similar ceremonies are believed by the same eminent authority to have extended over large areas. For instance, he lays down a northerly extension by a line drawn through what is now Sydney to the Lachlan River, down the latter to Balranald,† and of course southwards to those tribes already mentioned. He has, to my mind, conclusively shown that the Coast *Murring* attended the Boras of the *Kátūngal*, or "Sea-coast people," and of the *Kūrial* or "Northern people." The *Bora* of the Coast *Murring* called the *Kūringal* may be taken as the type of this large community.

Whatever may have been the origin of these carvings, it is interesting to be able to locate them chiefly within the territory of the two principal tribes inhabiting the Port Jackson District—the *Cammerragal* on the north, and the *Gweagal* on the south of the estuary.

The *Cammerragal*, or people of *Cammerray* or "North Shore," were a numerous and powerful tribe, extending from North Head to the Lane Cove River, north to the Hawkesbury, and thence eastwards to the coast again.‡ The *Gweagal*, or people of *Gwea*, on the contrary, possessed the country from the south shore of Port Jackson to away beyond Botany Bay.§ Collins tells us that the Cammerragals attended the *Bora*‖ of the neighbouring sub-tribes, and possessed the exclusive right of knocking out the initiate's tooth. According to Howitt, the suffix *gal* means those "of" or "belonging to"—thus the Coast *Murring* applied the word *Kátūngal* to all other peoples located on either side of them, in one direction into Gippsland, and in the other beyond Sydney.¶ It is a noteworthy fact that by far the most interesting groups of carvings are found in the country of the *Cammerragal*.

Going still farther afield, it is remarkable to find that even in Sarawak (North Borneo) representations of the human figure exist on rocks. Mr. F. Galton mentions the sprawling figure of a man carved in high relief on a large rock, and of the natural size, face downwards.**

* Journ. Arthnrop. Inst. Gt. Brit. and Ireland, 1884, XIII, p. 484.
† *Ibid.* p. 485.
‡ Hon. R. Hill, Notes on the Aborigines of N. S. Wales (Chicago Exposition, 1893), 1892, p. 1.
§ Collins, English Colony in N. S. Wales, 1804, p. 353. The Hon. G. Thornton locates this tribe on the north and south shores of Botany Bay (*Notes on the Aborigines of N. S. Wales* (*Chicago Exposition*, 1893), 1892, p. 7.
‖ Or, as it was there called, the *Yoolangh* (Thornton, *loc. cit.*)
¶ Howitt, *loc. cit.* 1886, XV, p. 418.
** Journ. Anthrop. Inst. Gt. Brit. and Ireland, 1892, XXI, p. 282.

XV.—On the Artificial Method of Lighting the Jenolan Caves: By W. S. LEIGH, Superintendent of Caves.

FROM the time of the discovery of the Jenolan Caves in 1841 up to 1868, the year in which they were reserved and brought under Government control, the most primitive of lights, viz., the torch and candle, seem to have been in general use for illuminating purposes. This means of lighting is responsible for the many smoke-discoloured patches noticed on the walls and ceilings of the older caves at Jenolan, and perhaps more so at the other principal cave centres, viz., Yarrangobilly, Wombeyan, and Wellington, where visitors had more of a free hand for a longer period. Curiously enough, these smoke patches mostly occur at those places in the caves where it has been found necessary during an inspection to call a halt; for instance, at the mouth of a narrow, intricate passage, or at the top of a steep declivity, where a portion of the party would be kept waiting while the leaders made headway.

This means of lighting would certainly give one an idea of the size of a cavity, but it remained for the later introduction, the magnesium lamp, to more effectually present to view the stalactitic adornments or beauty of a cave. In fact, as a means of illuminating any out-of-the-way nook or cranny, where the light has to be concentrated on one particular spot, this lamp even surpasses the latest introduction, the electric light. For general purposes however, by reason of the large area its rays will pierce, and being smokeless, a great consideration in an ill-ventilated cave, the electric light is certainly an improvement on anything yet introduced.

Electricity was first adopted as an illuminating agent at Jenolan, in the then principal cave, the "Imperial," in January, 1887. The motive power was a six-horse vertical engine, connected to a small dynamo capable of lighting twenty-five incandescent lamps, arranged in circuits of that number throughout the cave; it being only necessary for the guide, on reaching the end of a circuit, to switch on to the next, and so on. This means of lighting proving a success, the question of its extension naturally arose, but as the existing motive power would be inadequate, it was decided, on the suggestion of the late Government Geologist, Mr. C. S. Wilkinson, F.G.S., &c., to substitute water in lieu of steam for driving the dynamo. For this purpose advantage was taken of the never-failing supply and fall afforded by the underground river at Jenolan, by means of which ample power would be made available for all requirements, and the lights, in addition to being more constant, would be run on a far more economical basis.

An underground river rises to the surface about fifty feet below the northern entrance of the Grand Arch, near the junction of the Cave and McEwan's Creeks, at the rate of about one thousand gallons per minute. From this point, where it

is dammed, it is carried in wrought-iron pipes, twenty-two inches in diameter,* supported by concrete piers, a distance of six hundred and seventy feet, along the bed of Cave Creek, to the top of the first waterfall, a gradual fall of ten feet being allowed in this distance. As a further sheer fall of thirty-five feet to the bottom of the water-fall was obtainable, and this head of water alone being quite ample, the turbine water-wheel was erected in a bend of the creek at the bottom, thus a total fall of about forty-five feet from the dam was secured.

The turbine, one of Messrs. James Leffel and Co.'s Ten-inch Improved, is enclosed in a globe casing, the inlet being fifteen inches in diameter. The wheel is connected to a vertical spindle and now runs at a speed of eleven hundred revolutions per minute, the diameter of the pulley being regulated by that of the hundred-light Crompton Dynamo, to which it is connected direct by belt gearing, the dynamo requiring a speed of one thousand two hundred and sixty revolutions per minute.

With a circuit of one hundred incandescent lamps, the turbine exerts a force of about ten horse power, but in regular practice, in order to ensure the best results, the dynamo is not taxed to its full strength, a margin being allowed, which is effected by slightly reducing the number of lamps in the circuit.

As the flow of water through the turbine can be regulated to a nicety, its running has proved far more regular than that of the original motive power, the steam engine, consequently the lights have been much steadier, and in fact more brilliant.

Considering the difference in cost of generating steam in the one case and making use of running water in the other, also the great saving in labour in respect to the latter, we may conclude that the adoption of water as the motive power at Jenolan has answered most satisfactorily.

I may add, that having ample power at disposal, the extension of the electric light into the Lucas Cave has been decided upon, in fact the work is now nearing completion.

Another dynamo being required, it was found necessary to re-arrange the machines in the turbine house. Instead of driving direct from the turbine, as formerly, the two machines, the "Crompton" and the new "Western" dynamos, will be driven by means of counter shafting, the former for the Imperial and the latter for the Lucas Cave. In addition to the ordinary incandescent lamps, with which the passages will be lighted, six arc lamps will also be erected in the Lucas Cave, arranged so as to light up the large chambers.

By reason of the spaciousness of this cave, the arc lights will produce a novel and striking effect, and be the means of making an inspection of it quite as interesting as that of any cave at Jenolan.

* These pipes were kindly supplied by the Department of Public Works, they having formerly formed part of those in use for the Sydney Temporary Water Supply. If ordered specially, a pipe of smaller diameter would have answered this purpose.

XVI.—The Australian Geological Record for the Year 1893, with Addenda for 1891 and 1892: by R. ETHERIDGE, Junr., Palæontologist and Librarian, and W. S. DUN, Assistant Palæontologist and Librarian.

I.—Record for 1893.

ARCHIBALD (J. W.)—Origin and Distribution of Gold and Platinum, N. Coast Beaches, N.S.W. [No.] I. *Austr. Mining Standard,* 1893, IX, No. 230, p. 193; [No.] II, *Ibid,* No. 232, p. 230.

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II. RANDS, W. H.—Report of the Assistant Geologist [Gympie; Styx River Coal-field; Callide Creek Coal; Kilkivan Cinnabar; Olsen's and Johannsen's Caves; Stanwell and District], pp. 13–19, with map.

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XVII.—A Tabular List of the Bores and Water-Augers put down by the Department of Mines and Agriculture, N. S. Wales, and mentioned in the Reports of the Department: by W. S. Dun, Assistant Palæontologist and Librarian.

This list has been compiled with the object of systematising and simplifying reference to the numerous Bores and Water-augers that have been put down from time to time by the Department of Mines and Agriculture.

There are many cases in which the information given is very meagre, and, as a rule, no attempt has been made to fill these blanks. For instance, in many of the Bores and Water-augers put down in the Cretaceous Basin of the north-western portion of the Colony, the Cretaceous beds are almost always overlaid by more or less thick Post-Tertiary deposits, so that in many cases it is almost impossible to say—from the bore journals—where the more recent deposits end and the Cretaceous begin. This will account for the use of the term "Cretaceous ?," which signifies that no Palæontological evidence of a definite character has been obtained from the bore in question.

The plan adopted is the following:—(1) The name by which the Bore or Water-auger is generally known is given; (2) the district or locality; (3) the parish when stated; (4) the county; (5) the approximate geological horizon and formations passed through; (6) the depth in feet and inches; (7) the purpose for which it has been put down; and (8) the reference to the Report from which the evidence is obtained.

In the name column the numbers and letters are given as in the original references, but those in round brackets have been put in by myself.

Name.	Locality.	Parish.	County.	Geological Formation.	Depth in feet, &c.	Purpose	Reference.
A. A. Co.'s Platt's Estate.	Platt's Estate, Newcastle.	Newcastle..	Northumberland.	Newcastle, or Upper, Coal Measures.	1,049·0	Coal ..	1879, pp. 207, 208.
Adamstown	Adamstown	" ..	"	" " ..	202·0	" ..	1885, p. 160.
"	"	" ..	"	" " ..	77·6	" ..	1883, p. 188.
Allison's	Mullet Ck., Hawkesbury River.	Patonga ..	"	Hawkesbury Sandstone, Chocolate Shales.	1,300·0	" ..	1879, to face p. 208.
Ana Bay (1)	Ana Bay	Tomaree ..	Gloucester	Æolian; Carboniferous; Porphyry.	318·1	" ..	1890, p. 157.
" (2)	"	" ..	"	Æolian and Carboniferous.	449·5	" ..	1890, p. 159.
" (3)	"	" ..	"	Æolian; Carboniferous; Basalt, Serpentine.	1,213·1	" ..	1891, Diag. 10.
Angledool (1) ..	Sandridge Reserve, Angledool.	Mundoo ..	Finch	Post-Tertiary	123·6	Water..	1884, p. 230.
" (2) ..	" ..	" ..	"	"	54·0	" ..	1884, p. 231.
" (3) ..	" ..	" ..	"	"	63·0	" ..	1884, p. 232.
" (4) ..	" ..	" ..	"	"	58·0	" ..	1884, p. 233.
" (5) ..	" ..	" ..	"	"	133·0	" ..	1884, p. 234.
" (6) ..	" ..	" ..	"	"	490·6	" ..	1884, p. 235; 1885, p. 186.

Name.	Locality.	Parish.	County.	Geological Formation.	Depth in feet, &c.	Purpose	Reference.
Apple-tree Creek	Apple-tree Creek, Minmi.	Hexham ..	Northumberland.	Newcastle, or Upper Coal Measures.	·681·3	Coal ..	1885, p. 163.
Araluen, No. 1..	Araluen	....	St. Vincent	Post-Tertiary and Granite.	24·0	....	1883, p. 215.
" No. 2..	"	....	" ..	" " ..	24·6	....	1883, p. 215.
" No. 3..	"	....	" ..	Post-Tertiary	30·6	....	1883, p. 216.
" No. 4..	"	....	" ..	"	7·0	Gold (little).	1883, p. 216.
" No. 5..	"	....	" ..	Post-Tertiary and Granite.	41·3	....	1883, p. 217.
" No. 6..	"	....	" ..	" " ..	41·5	....	1883, p. 217.
Ash Island	Ash Island	Newcastle..	Northumberland.	Newcastle, or Upper Coal Measures.	1,102·4	Coal ..	1888, pp. 220, 221.
Ballimore, 1	Ballimore	Murrungundie.	Lincoln ..	Ballimore Coal Measures.	561·6	" ..	1886, p. 188; 1891, App. 13.
" 2....	"	" ..	" ..	" " ..	794·6	" ..	1887, p. 188.
" 3....	"	" ..	" ..	" " ..	1,101·4	" ..	1887, p. 189; 1888, p. 217.
Barber's Creek..	Barber's Creek	Marulan ..	Argyle	Mittagong, or Upper Coal Measures.	670·6	" ..	1883, p. 193.
Barrigun, No. 1	Barrigun Holding..	....	Culgoa	Post-Tertiary and Cretaceous.	192·2	Water..	1885, p. 193.
Barrigun	" ..	Barrigun ..	"	" " ..	745·0	" ..	1891, App. 62.
Belalie (1)	Belalie Holding	....	Irrara	" " ..	1,600·0	" ..	1891, App. 58.
" (2)	" 2 mls. S. of 12 ml. peg Queensland Boundary, E. of Warrego.	....	Culgoa	" " ..	1,698·0	Water..	1891, App. 32.
" (3)	Belalie Holding	....	Irrara	" ..	1,160·0	" ..	1891, App. 33.
Berrima Colliery	Berrima	....	Camden ..	Mittagong, or Upper Coal Measures.	92·6	Coal ..	1883, p. 130.
Bingara (1)	Jones' Flat, Bingara	Bingara ..	Murchison	Post-Tertiary and Serpentine.	36·6	Water .	1886, p. 199.
" (2)	Gaol Well, Bingara	" ..	"	Post-Tertiary	47·0	" ..	1886, p. 199.
" (3)	Cemetery Flat, Bingara.	" ..	"	Post-Tertiary and Silurian?	63 6	" ..	1886, p. 200.
" Upper (1)	Upper Bingara	" ..	"	Granite	117·2	....	1885, p. 171.
" " (2)	"	" ..	"	Diorite	140·0	....	1885, p. 172.
" " (3)	"	" ..	"	"	103·0	....	1885, p. 173.
Black Gully	Emmaville	Strathbogie North.	Gough	Basalt and Granite ..	74·5	Tin....	1883, p. 194.
Bourke (1)......	18 m. W. of Bourke	....	Gunderbooka.	Post-Tertiary and Cretaceous?	194·4	Water..	1883, p. 196.
" (2)......	" "	....	"	" " ..	198·3	" ..	1883, p. 199.
" (1)......	51 m. W. of Bourke	Goonery ..	Barrona ..	Post-Tertiary........	89·2	" ..	1883, p. 200.
" (2)......	" "	" ..	" ..	"	84·6	" ..	1883, p. 201.
" (3)......	" "	" ..	" ..	"	114·0	" ..	1883, p. 201.
" (4)......	" "	" ..	" ..	"	103·0	" ..	1883, p. 202.
" (5)......	" "	" ..	" ..	Post-Tertiary and Cretaceous?	200·3	" ..	1883, p. 203.
" (A)......	18 m. W. of Bourke	....	Gunderbooka.	Post-Tertiary........	194·6	" ..	1884, p. 222.
" (B)......	51 m. W. of Bourke	Goonery ..	Barrona ..	Post-Tertiary and Cretaceous?	89·2	" ..	1884, p. 223. 1891, App. 15.
" (B^{1})....	51 m. 5 ch. W. of Bourke.	" ..	" ..	" " ..	84·6	" ..	1884, p. 224.
" (B^{2})....	51 m. W. of Bourke.	" ..	" ..	Post-Tertiary	114·0	" ..	1884, p. 225.
" (B^{2} 2nd.)	" " ..	" ..	" ..	"	103·0	" ..	1884, p. 226.
" (B^{3})....	51½ m. W. of Bourke	" ..	" ..	Post-Tertiary and Cretaceous?	200·8	" ..	1884, p. 227.
" (C)	18 m. W. of Bourke	....	Gunderbooka.	" " ..	198·3	" ..	1884, p. 228.
" (D)	57 m. W. of Bourke	....	Barrona ..	" " ..	545·6	" ..	1884, p. 229; 1885, p. 183.
" (E)	75 mile-post Bourke to Wanaaring Road.	Wanga	" ..	" " ..	960·0	" ..	1885, p. 184; 1886, p. 195; 1891, App. 12.
" (F)	94 mile-post Bourke to Wanaaring Road.	....	" ..	" " ..	321·7	" ..	1885, p. 185.
" (F^{2})....	101½ mile-post Bourke to Wanaaring Road.	Paroo	Irrara	" " ..	965·0	" ..	1887, p. 209; 1891, App. 14.
" No. 4...	Bourke............	East Bourke	Cowper ..	Post-Tertiary; Cretaceous? and Silurian?	1,467·0	" ..	1891, App. 6.
Breakfast Creek.	Breakfast Creek ..	Penrith ..	Cumberland.	Hawkesbury Sandstone.	787·1	Coal ..	1884, p. 180.

Name.	Locality.	Parish.	County.	Geological Formation.	Depth in Feet, &c.	Purpose	Reference.
Broken Hill	Broken Hill	Picton ..	Yancowinna.	Gneiss and Granite ..	2,123·9	....	1887, p. 191; 1888, p. 218; 1889, p. 152; 1890, p. 161.
Buckanba	Buckanba Holding..	Wygilla....	Rankin....	Recent and Post-Tertiary.	725·0	Water	1891, App. 20.
Bulli	Bulli	....	Camden ..	Upper Coal Measures .	805·3	Coal ..	1891, Diag. 13.
" (2)........	"	....	" ..	" ..	865·4	" ..	1892, p. 79.
" (3)........	"	....	" ..	" ..	......	" ..	1892, p. 81.
Bundanoon	Bundanoon........	....	Camden ..	Coal Measures	720·3	Coal ..	1886, p. 185.
" (2) ..	"	....	"	"	380·1	" ..	1887, p. 186.
Burwood	Concord Tannery, Burwood.	Concord ..	Cumberland.	Hawkesbury—Wianamatta Series.	218·0	Water	1884, p. 237.
Buttai	Buttai	Stockrington.	Northumberland.	Tomago, or Middle Coal Measures.	1,300·0	Coal .	1889, p. 145.
Catherine Hill Bay.	Catherine Hill Bay	Wallarah ..	"	Newcastle, or Upper Coal Measures.	262·9	" ..	1876, p. 139.
Cessnock	Cessnock	Cessnock ..	"	Greta, or Lower Coal Measures.	1,220·0	" ..	1890, p. 155. 1891, Diag. 7.
City Railway Extension.	Sydney............	Sydney....	Cumberland.	Hawkesbury Sandstone.	11·0 to 64·0	....	1884, pp. 192-212.
Clarence Siding..	Clarence Siding....	....	Cook......	Hawkesbury Sandstone, Chocolate Shales; Upper Coal Measures.	1,040·6	Coal ..	1885, p. 155. 1886, p. 183. 1887, p. 187.
Coalcliff	Coalcliff	Southend..	Cumberland.	" "	2,350·0	" ..	1879, p. 208.
Coal Point	Coal Point, Lake Macquarie.	Awaba	Northumberland.	Newcastle, or Upper Coal Measures.	902·0	" ..	1884, p. 181.
Cockle Creek ..	Cockle Creek, Lake Macquarie.	Teralba ..	"	" "	803·2	" ..	1884, p. 183.
Cobar Copper Mine (i-viii).	Cobar Copper Mine	....	Robinson..	Silurian, &c.	24·0-3 26·0	Copper	1884, pp. 186-187
Colo Vale (1)....	Colo Vale	Mittagong.	Camden ..	Hawkesbury Sandstone; Upper Coal Measures.	345·0	Coal ..	1884, p. 171.
" (2)....	"	" ..	" ..	" "	830·7	" ..	1884, p. 172.
" (3)....	"	" ..	" ..	" "	947·3	" ..	1884, p. 177.
" (4)....	"	" ..	" ..	" "	1,181·0	" ..	1884, p. 178. 1885, p. 161.
Cremorne (1)..	Cremorne	Willoughby	Cumberland.	Hawkesbury Series, Narrabeen Shales, Chocolate Shales; Newcastle, or Upper Coal Measures.	3,095·0	" ..	1890, p. 159. 1891, Diags. 10, 11.
" 2 ..	"	"	"	" "	2,929·0	" ..	1892, p. 77. 1893, p. 77.
Dempsey Island	Dempsey Island ..	Newcastle .	Northumberland.	Newcastle, or Upper Coal Measures.	938·0	" ..	1884, p. 182.
"	" " ..	" ..	"	" "	2,001·7	" ..	1885, p. 166.
Dora Creek	Dora Creek, Lake Macquarie.	Cooranbong.	"	" "	475·10	" ..	1883, p. 186.
Doughboy Hollow.	Doughboy Hollow..	....	Buckland..	Coal Measures	283·5	" ..	1892, p. 75.
Dunlop (1)......	Dunlop Holding ..	Singoramba.	Barrona ..	Post-Tertiary and Cretaceous.	620·0	Water.	1891, App. 24.
" (2)......	Dunlop Holding, 12 miles S. of No. 1 Bore.	Goolgumbla.	Landsborough	" "	940·0	"	1891, App. 25.
" (3)......	Dunlop Holding, 8 miles S.E. of No. 2 Bore.	Coonong or Coree.	"	" "	860·0	"	1891, App. 26.
" (4)......	Dunlop Holding ..	Coonong ..	"	" "	750·0	"	1891, App. 27.
" (5)......	" " ..	Tindeanbah	"	" "	1,200·0	"	1891, App. 28.
Dunumbral	Dunumbral Holding	....	Finch	" "	2,070·0	"	1891, App. 23.
Fassiefern	Fassiefern	Awaba	Northumberland.	Newcastle, or Upper Coal-measures.	1,153·9	Coal ..	1888, p. 216. 1889, p. 151.
"	"	"	"	" "	528·9	" ..	1889, p. 147.
Ferndale Est. (1)	Ferndale Estate ..	Newcastle..	"	" "	180·0	" ..	1880, p. 206.
" (2)	Ferndale Est. Gravel Quarry.	" ..	"	" "	111·7	" ..	1880, p. 206.
" (3)	"	" ..	"	" "	102·0	" ..	1880, p. 206.
" (4)	"	" ..	"	" "	100·0	" ..	1880, p. 206.
Flaggy Creek ..	Flaggy Creek......	Kahibah ..	"	" "	483·1	" ..	1880, pp. 206-208
" (2)	Flaggy Creek, near Red Head Lagoon.	" ?..	"	" "	337·5	" ..	1881, pp. 121-125
" (3)	Red Head Lagoon, ½-mile from.	" ..	"	" "	....	" ..	1881, p. 122.
Folly Coal-fields	Waratah	Newcastle..	"	" "	383·10	" ..	1886, p. 191.

Name.	Locality.	Parish.	County.	Geological Formation.	Depth in Feet, &c.	Purpose	Reference.
Forbes (1)	Forbes	....	Ashburnham.	Post-Tertiary	169·0	Water	1886, p. 201.
„ (2)	„	....	„	Post-Tertiary and Silurian.?	104·0	„	1886, p. 202.
„ (3)	„	....	„	„ „	74·6	„	1886, p. 203.
„ (4)	„	....	„	„ „	57·6	„	1886, p. 204.
„ (5)	„	....	„	„ „	105·0	„	1886, p. 205.
„ (6)	„	....	„	„ „	80·6	„	1887, p. 199.
„ (7)	„	....	„	„ „	151·6	„	1887, p. 200.
„ (8)	„	....	„	„ „	144·0	„	1887, p. 201.
„ (9)	„	....	„	„ „	146·0	„	1887, p. 202.
„ (10)	„	....	„	„ „	123·0	„	1887, p. 203.
„ (11)	„	....	„	„ „	164·0	„	1887, p. 204.
„ (12)	„	....	„	„ „	127·0	„	1887, p. 205.
„ (13)	„	....	„	„ „	184·6	„	1887, p. 206.
„ (14)	„	....	„	„ „	193·6	„	1887, p. 207.
Fort Bourke	Fort Bourke Holding.	....	Gunderbooka.	Post-Tertiary and Cretaceous.	1,284·0	„	1891, App. 55.
Fullerton Cove	Fullerton Cove	Newcastle	Northumberland.	Newcastle, or Upper, Coal Measures.	954·6	Coal	1883, p. 195.
Girilambone (A)	Girilambone	....	Cambelago	Post-Tertiary	155·6	Water	1883, p. 208.
„ (B)	„	....	„	„	120·0	„	1883, p. 209.
„ (C)	„	....	„	„ and Silurian?	100·3	„	1883, p. 210.
„ (D)	„	....	„	Post-Tertiary	112·6	„	1883, p. 211.
Gladesville 1	Gladesville Asylum	Ryde	Cumberland	Hawkesbury Sandstone.	442·1	„	1883, p. 189.
„ 2	„ „	„	„	„ „	197·10	„	1883, p. 190.
„ 3	„ „	„	„	„ „	365·3	„	1883, p. 191.
Glen Oak	Seaham	Seaham	Durham	Coal-Measures and tuffs.	501·0	Coal	1889, p. 153.
Goodooga 1	Goodooga	....	Culgoa	Post-Tertiary and Cretaceous (?)	104·0	Water	1885, p. 191.
„ 2	„	....	„	„	132·0	„	1885, p. 192.
Gorion Station, 1	Gorion Station, Narrabri.	....	Nandewar	Post-Tertiary	218·7	„	1884, p. 242.
„ „ 2	„	....	„	„	271·6	„	1884, p. 243.
„ „ 3	„	....	„	„	159·6	„	1885, p. 196.
„ „ 4	„	....	„	„	194·0	„	1885, p. 197.
„ „ 5	„	....	„	„	151·0	„	1885, p. 198.
„ „ 6	„	....	„	„	173·6	„	1885, p. 199.
Grafton, 1	Grafton	....	Clarence	„	43·6	„	1883, p. 212
„ 2	„	....	„	„	46·0	„	1883, p. 213.
„ 3	„	....	„	„	21·0	„	1883, p. 213
„ 4	„	....	„	„ and Clarence Series.	184·0	Water and Coal	1883, p. 214.
„ [5]	„	....	„	„	184·0	„	1884, p. 236.
Gulgong 1–3	Gulgong	....	Phillip	Tertiary	163, 205, 168	Drift and Basalt.	1890, pp. 143–147
„ 4–8	„	....	„	„	120–154	Basalt and Drift.	1891, Diags. 1–5.
Gunnedah 1	Gunnedah	....	Pottinger	Post-Tertiary	53·0	Water	1883, p. 204.
„ 2	„	....	„	„	25·0	„	1883, p. 204.
„ 3	„	....	„	„	23·0	„	1883, p. 204.
„ 4	„	....	„	„	40·11	„	1883, p. 204.
„ 5	„	....	„	„	59·9	„	1883, p. 205.
„ 6	„	....	„	„	40·6	„	1883, p. 205.
„ 7	„	....	„	„	30·0	„	1883, p. 205.
„ 8	„	....	„	„	48·0	„	1883, p. 206.
„ 9	„	....	„	„	33·6	„	1883, p. 206.
„ 10	„	....	„	„	132·3	„	1883, p. 207.
„	„	....	„	„	132·3	„	1884, p. 238.
Hamilton 1	Hamilton	Newcastle	Northumberland.	Newcastle, or Upper, Coal Measures.	323·0	Coal	1884, p. 188.
„ 2	„	„	„	„ „	200·6	„	1884, p. 189.
„ 3	„	„	„	„ „	200·3	„	1884, p. 190.
„ 4	„	„	„	„ „	211·10	„	1884, p. 191.
Hay 1	Gunbar Road	....	Waradgery	Post-Tertiary and Cretaceous?	400·0	Water	1885, p. 204; 1886, p. 205.
„ 2	„	....	„	„	885·1	„	1887, p. 208
Heathcote	Heathcote	Heathcote	Cumberland	Hawkesbury Sandstone; Upper Coal Measures.	1,085·7	Coal	1885, p. 176.
Hexham Island	Hexham Island	Hexham	Northumberland.	Newcastle, or Upper Coal Measures.	702·4	„	1888, p. 219.
Holt-Sutherland, Botany.	Holt-Sutherland Estate, Botany.	Sutherland	Cumberland	Hawkesbury Sandstone, Chocolate Shales.	2,200·0	„	1879, p. 208.
„	„	„	„	„ „	1,008·6	„	1883, p. 197
„	„	„	„	Hawkesbury Series; Upper Coal Measures	2,307·8	„	1886, p. 189.

Name.	Locality.	Parish.	County.	Geological Formation.	Depth in Feet, &c.	Purpose	Reference.
Joadja 1	Joadja	....	Camden ..	Upper Coal Measures.	365·1	Coal ..	1888, p. 208.
„ 2	„	....	„ ..	„ „	382·0	„ ..	1888, p. 209.
„ 3	„	....	„ ..	„ „	256·7	„ ..	1889, p. 142.
„ 4	„	....	„ ..	„ „	490·11	„ ..	1889, p. 143.
„ 5	„	....	„ ..	„ „	357·2	„ ..	1889, p. 150. 1890, p. 153.
Kallara 1	Kallara Holding, Mullyee Well.	Mulyee....	Killara....	Post-Tertiary........	46·0	Water.	1891, App. 42.
„ 2	Kallara Holding, Wee Watha.	Undelcawa	„ ..	„	140·0	„ ..	1891, App. 43.
„ 3	„ „ ..	Binbooker.	„ ..	„ and Cretaceous ?	600·0	„ ..	1891, App. 44.
„ 4	„ „ ..	Parkin	Fitzgerald.	„ „	820·0	„ ..	1891, App. 45.
„ 5	Kallara Holding, Moonooloo, 5th Well	Moonooloo.	Killara....	„ „	900·0	„ ..	1891, App. 46.
„ 6	Kallara Holding, Box Bore, 6th Well.	....	„ ..	„ „	1,411·0	„ ..	1891, App. 47.
„ 7	Kallara Holding, Neefeenyah Bore, 6th Well.	Tutty	„ ..	„ „	540·0	„ ..	1891, App. 48.
„ 8	Kallara Holding, Paradise Bore, 8th Well.	Calpacaira.	„ ..	„ and Silurian ?	931·0	„ ..	1891, App. 49.
„ 9	Kallara Holding, Gum Lake, 9th Well	Paroo	„ ..	Post-Tertiary and Cretaceous.	676·0	„ ..	1891, App. 50.
„ 10	Kallara Holding, Tonga Bore, 10th Well.	Mulawoolka	„ ..	„ „	730·0	„ ..	1891, App. 51.
„ 11	Kallara Holding, Mungundi Lake Bore, 11th Well.	....	„ ..	„ „	760·0	„ ..	1891, App. 52.
Kerribree 1	Kerribree Holding.	....	Barrona ..	„ „	1,073·0	„ ..	1891, App. 38.
„ 2	„ „ ..	....	„ ..	„ „	1,340·0	„ ..	1891, App. 39.
Leconfield 1 ..	Leconfield Estate ..	Branxton..	Northumberland.	Coal Measures	459·8	Coal ..	1884, pp. 150, 173.
„ 2 ..	„ „ ..	„ ..	„ ..	„	96·7	„ ..	1884, p. 174.
„ 3 ..	„ „ ..	„ ..	„ ..	„	70·1	„ ..	1884, p. 175.
„ 4 ..	„ „ ..	„ ..	„ ..	„	616·0	„ ..	1884, p. 176. 1885, p. 156.
Lidsdale 1 ..	Lidsdale, near Wallerawang.	....	Cook......	Upper Coal Measures.	437·1	„ ..	1884, p. 184.
„ 2 ..	" "	....	„	„ „ ..	355·1	„ ..	1884, p. 185.
Lochend	Lochend	....	Northumberland.	Newcastle, or Upper Coal Measures.	1,300·0	„ ..	1888, pp. 212–213. 1889, p. 144.
Long Swamp ..	Long Swamp, Marulan.	Marulan ..	Argyle	....	702·11	„ ..	1883, p. 192.
Louth	Louth-Wanaaring Road, 26-mile post.	....	Landsborough.	Post-Tertiary and Cretaceous.	575·0	Water..	1891, App. 8.
L. T. Creek	L. T. Creek, near Lake Macquarie.	Awaba	Northumberland.	Newcastle, or Upper Coal Measures.	524·9	Coal ..	1883, p. 184.
Lucknow 1 ..	Lucknow, Orange..	....	Bathurst ..	Basalt and Alluvium	140·0	Gold ..	1885, p. 174.
„ 2 ..	„ „ ..	....	„ ..	Silurian, Serpentine, and Drift.	231·9	„ ..	1885, p. 175.
Maitland Gaol ..	East Maitland Gaol.	East Maitland.	Northumberland.	Tomago, or Middle Coal Measures.	745·9	Coal ..	1884, p. 179.
Marra 1	Marra Holding	Balara	Killara	Post-Tertiary, Cretaceous and Silurian ?	1,482·0	Water..	1891, App. 21.
„ 2	„ „	....	„	Post-Tertiary and Cretaceous.	895·0	„ ..	1891, App. 22.
Milparinka 1 ..	Milparinka	....	Evelyn	„ „	100·0	„ ..	1891, App. 19.
„ 2 ..	106-mile post, Milparinka to Wanaaring Road.	....	Ularara ..	„ „	1,296·0	„ ..	1888, p. 228. 1889, p. 161. 1890, p. 175. 1891, p. 183. 1891, App. 4.
„ 3 ..	121 Mile-post, Milparinka to Wanaaring Road.	....	„ ..	„ „	1,303·0	„ ..	1888, p. 229. 1889, p. 162. 1890, p. 177. 1891, p. 185. 1891, App. 3.
„ 4 ..	91 Mile-post, Milparinka to Wanaaring Road.	....	„ ..	„ „	......	„ ..	1888, p. 230. 1891, App. 16.
„ 11 ..	Milparinka	....	Evelyn....	„ „	218·3	„ ..	1888, p. 233. 1889, p. 164.
Mittagong......	Mittagong	....	Camden ..	Upper Coal Measures.	657·6	Coal ..	1887, p. 190.
Momba 1	Momba Holding. ..	Charlton ..	Fitzgerald.	Post-Tertiary and Cretaceous ?	1,505·0	Water.	1891, App. 60.
„ 2	„	Pachungi..	Yungnulgri	Post-Tertiary; Cretaceous; and Silurian ?	1,261·0	„ ..	1891, App. 61.

Name.	Locality.	Parish.	County.	Geological Formation.	Depth in Feet, &c.	Purpose	Reference.
Monk-Wearmouth 1	Monk-Wearmouth, Minmi.	Hexham ..	Northumberland.	Coal Measures	705·4	Coal ..	1885, p. 167.
„ 2	„	„	„	„	491·4	„ ..	1885, p. 168.
„ 3	„	„	„	„	657·6	„ ..	1885, p. 169.
Moongulla	Moongulla	....	Finch	Post-Tertiary and Cretaceous?	1,777·0	Water.	1891, App. 6.
Moongulla Reserve 1	„	....	„	„ „	326·0	„ ..	1885, p. 187. 1886 p. 196.
Moore Bank	Liverpool	Holsworthy	Cumberland.	Hawkesbury Series—Narrabeen Shales.	2,601·0	Coal ..	1889, p. 148. 1890, p. 149.
Moschito Island.	Moschito Island	Newcastle..	Northumberland.	Newcastle, or Upper Coal Measures.	617·1	„ ..	1883, p. 196.
Native Dog	Leila Springs	Leila	Gunderbooka.	Post-Tertiary and Cretaceous?	475·0	Water.	1891, App. 10.
New Lambton ..	Adamstown	Newcastle..	Northumberland.	Newcastle, or Upper Coal Measures.	243·1	Coal ..	1886, p. 190.
New Lambton Colliery Co.	New Lambton	Stowell	Gloucester.	„ „	272·0	„ ..	1882, p. 124.
Nicoleche 1	Nicoleche Holding..	....	Barrona ..	Cretaceous?	916·0	Water.	1891, App. 29.
„ 2	„	....	Ularara ..	Cretaceous and Granite.	1,500·0	„ ..	1891, App. 30.
„ 3	„	....	Barrona ..	„ „	1,227·0	„ ..	1891, App. 31.
Nobby's	Newcastle	Newcastle..	Northumberland.	Newcastle, or Upper Coal Measures.	324·3	Coal ..	1891, Diag. 3.
North Shore	North Shore	Willoughby	Cumberland	Hawkesbury Series ..	401·5	....	1885, p. 162.
Nowra	Nowra	....	St. Vincent	Upper Coal-Measures.	1,423·4	Coal ..	1890, p. 151.
Nyngan	Portion 71, Nyngan	Nyngan ..	Oxley	Post-Tertiary, Cretaceous.	520·6	Water.	1891, App. 7.
Outer Netallie ..	Outer Netallie, Wilcannia to Silverton-road.	....	....	„ „	83·0	„ ..	1884, p. 240.
„ A	„	....	....	„ „	319·10	„ ..	1884, p. 241. 1885, p. 194.
Pelican Flat 1..	Pelican Flat, Lake Macquarie.	....	Northumberland.	Newcastle, or Upper Coal Measures.	1,000·1	Coal ..	1885, p. 177.
„ 2..	„	....	„	„ „	246·5	„ ..	1885, p. 178.
Penrith	Penrith	....	Cumberland	Hawkesbury Sandstone	434·3	„ ..	1885, p. 165.
Pirillie 1	Pirillie Holding	....	Irrara	Post-Tertiary and Cretaceous.	613·0	Water.	1891, App. 41.
„ 2	„	....	....	„ „	803·0	„ ..	1891, App. 59.
Port Waratah 1	Port Waratah	Newcastle..	Northumberland.	Newcastle, or Upper Coal Measures.	303·0	Coal ..	1885, p. 157.
„ 2	„	„ ..	„ ..	„ „	141·0	„ ..	1885, p. 158.
„ 3	„	„ ..	„ ..	„ „	273·2	„ ..	1885, p. 159.
Ravensworth 1..	Ravensworth	....	„ ..	Greta, or Lower Coal Measures.	990·9	„ ..	1889, p. 154. 1890, p. 165.
„ 2..	„	....	„ ..	„ „	1,001·2	„ ..	1890, p. 167.
Redhead 1	Charlestown	Kahibah ..	„ ..	Newcastle, or Upper Coal Measures.	797·10	„ ..	1885, p. 170. 1886, p. 186.
„ 2	„	„ ..	„ ..	„ „	935·7	„ ..	1886, p. 187.
„ 3	„	„ ..	„ ..	„ „	857·0	„ ..	1887, p. 186. 1888, p. 211.
Rocky Mouth ..	Rocky Mouth, Clarence River.	....	Clarence ..	Clarence Coal Measures.	403·4	Coal ..	1885, p. 164.
Salisbury Downs. 1	Salisbury Downs Holding.	....	Tantara ..	Post-Tertiary and Cretaceous.	1,365·0	Water..	1891, App. 36.
„ 2	„ „	....	„ ..	„ „	1,568·0	„	1891, App. 37.
South Redhead..	South Redhead	Kahibah ..	Northumberland.	Newcastle, or Upper Coal-measures.	895·0	Coal ..	1888, p. 149.
Snake's Creek ..	Snake's Creek, Charlestown.	Newcastle..	„	„ „	997·6	„ ..	1888, p. 210.
Stanwell Park 1	Stanwell Park	Southend..	Cumberland	Hawkesbury Series; Upper Coal-measures	438·1	„ ..	1888, p. 181.
„ 2	„	„	„	„ „	248·10	„ ..	1888, p. 182.
„ 3	„	„	„	„ „	270·1	„ ..	1883, p. 183.
Stockton Coal Company.	Stockton	Stowell ..	Gloucester.	Newcastle, or Upper Coal-measures.	341·7	„ ..	1876, p. 140. 1882, p. 121–122
Stringer's Hill ..	Stringer's Hill	....	....	Post-Tertiary; Cretaceous,?and Silurian.?	248·2	Water	1890, p. 179.
Sunny Corner 1..	Sunny Corner	....	Mitchell ..	Silurian Sandstones and Slates.	401·0	Silver..	1886, p. 192. 1887, p. 192.
„ 2..	„	....	„	Silurian and Porphyry	657·0	„ ..	1887, p. 193.
Teralba	Teralba, Lake Macquarie.	Awaba	Northumberland.	Newcastle, or Upper Coal-measures.	568·0	Coal ..	1883, p. 185.
Tibbooburra 1..	Tibbooburra	....	Tongowaka	Post-Tertiary; Cretaceous; Silurian.?	288·0	Water	1888, p. 231. 1891, App. 17.
„ 2..	„	....	„	„ „	417·6	„	1888, p. 232 1889, p. 163. 1890, p. 181. 1891, App. 18.

Name.	Locality.	Parish.	County.	Geological Formation.	Depth in Feet, &c.	Purpose	Reference.
Tulcumbah	Tulcumbah, near Carrol.	....	....	Post-Tertiary	264·0	Water..	1884, p. 239.
Wallarah	Wallarah	Wallarah ..	Northumberland.	Hawkesbury Series; Newcastle, or Upper Coal Measures.	286·10	Coal ..	1882, pp. 127-129.
Wangamana	Wangamana Holding	....	Barrona ..	Post-Tertiary and Cretaceous.	1,600·0	Water	1891, App. 40.
Waratah........	Waratah	Newcastle	Northumberland.	Newcastle, or Upper Coal Measures.	1,127·6	Coal ..	1891, Diag. 6.
Waratah Coal Co. 1	Waratah Estate....	,,	,,	,, ,,	210·10	,, ..	1878, Sec. 10.
,, 2	John's Farm	,,	,,	,, ,,	153·8	,, ..	1878, Sec. 11.
,, 3	Waratah Estate....	,,	,,	,, ,,	148·7	,, ..	1878, Sec. 12.
,, 4	Waratah, near Loco. tank.	,,	,,	,, ,,	363·10	,, ..	1878, Sec. 14.
Weilmoningle 1..	Weilmoningle Holding.	....	Culgoa	Post-Tertiary and Cretaceous.	2,005·0	Water..	1891, App. 56.
,, 2..	,, ,,	....	,,	,, ,,	1,590·0	,, ..	1891, App. 57.
Werris Creek 1..	Werris Creek......	....	Buckland ..	....	672·0	,, ..	1885, p. 179.
,, 2.	,, ...	....	,,	....	295·11	,, ..	1885, p. 180.
West Wallsend Co.	Wallsend	Teralba....	Northumberland.	Newcastle or Upper Coal Measures.	718·6	Coal ..	1883, pp. 137,138
Wilcannia B....	C.R. 604, Wilcannia to Silverton road	....	....	Post-Tertiary and Cretaceous. ?	146·6	Water..	1885, p. 188.
,, C....	C.R. 605, Wilcannia to Silverton road	....	....	,, ,,	75·8	,, ..	1885, p. 183.
,, D....	C.R. 606, Wilcannia to Silverton road	....	....	,, ,,	....	,, ..	1885, p. 195.
,, E....	C.R. 607, Wilcannia to Silverton road	....	....	,, ,,	....	,, ..	1885, p. 190.
,, J....	64 Ml. W.R. Wilcannia to Silverton road.	....	....	,, ,,	210·9	,, ..	1885, p. 202.
,, K....	W.R. 545, Wilcannia to Silverton road	....	....	,, ,,	56·0	,, ..	1885, p. 201.
L....	C.R. 612, Wilcannia to Silverton road	....	....	Post-Tertiary, Slate and Granite.	89·9	,, ..	1884, p. 244. 1885, p. 200.
,, H....	Yancowinna Pls., Wilcannia to Silverton road.	....	....	Post-Tertiary and Cretaceous?	250·3	,, ..	1885, p. 203.
,, EE....	Glenlyon Station ..	....	....	,, ,,	229·2	,, ..	1886, p. 197.
,, CC....	Calker's Well	....	....	,, ,,	250·5	,, ..	1886, p. 198.
Woodford 1	Woodford	....	Cook......	Hawkesbury Series; Upper Coal Measures.	1,658·6	Coal ..	1888, p. 214.
,, 2	,, ...	....	,, ...	,, ,,	1,394·8	,, ..	1888, p. 215. 1889, p. 146.
Wyee	Wyee	Wallarah ..	Northumberland.	,, ,,	946·8	,, ..	1890, p. 169. 1891, Diag. 12.
Wyong 1	Wyong	Munmorah	,,	Hawkesbury Series; Upper Coal Measures.	901·0	,, ..	1882, p. 129. 1883, p. 187.
,, 2	,, ...	,,	,,	,, ,,	897·0	,, ..	1882, pp. 129-130.
Yacaaba	Yacaaba	....	Gloucester	Coal Measures	675·0	,, ..	1892, p. 83: 1893, Diag. 3.
Yancannia 1....	Yancannia Holding	Cockulby ..	Yantara ..	Post-Tertiary and Cretaceous.	268·0	Water..	1891, App. 53.
,, 2....	,,	....	,, ..	,, ,,	303·0½	,, ..	1891, App. 54.
Yanda 1........	Yanda Holding	....	Cowper ..	Post-Tertiary; Cretaceous; Silurian?	750·0	,, ..	1891, App. 34.
,, 2........	,, S. 37° E., 10 mls. from Paroo River.	....	,, ..	,, ,,	1,008·0	,, ..	1891, App. 35.
Yantabulla	W.R. 162, Bourke to Hungerford Road.	Mucruss ..	Irrara	,, ,,	210·0	,, ..	1891, App. 11.
Youngarina	W.R. 159	Youngarina	,, ...	Post-Tertiary; Cretaceous?	165·0	,, ..	1891, App. 9.
Young Wallsend	Young Wallsend Mine.	....	Northumberland.	Newcastle, or Upper Coal Measures.	470·5	Coal ..	1886, p. 184.

XVIII.—On the Geological Structure of the Wyalong Gold-field: By E. F. PITTMAN, A.R.S.M., Government Geologist.

Situation.—The Wyalong gold-field is situated on the Wollongough Road, about forty miles in a north-westerly direction from the terminus of the railway at Temora.

Topographical and Geological features.—The country where the gold has been discovered consists of level plains covered with dense mallee scrub, and occasional belts of ironbark and box, while at long intervals are seen low ridges covered with cypress pine.

The surface of the plains consists, to a depth of two or three feet, of red and black clayey soils of Pleistocene age, with ironstone pebbles and occasional subangular fragments of quartz.

The pine ridges in the vicinity of the Government township of Wyalong are formed of hard rocks, consisting of hornblendic granite, diorite, and felsite, with slates, sandstones, and quartzites—the three latter probably of Upper Silurian age. The hornblendic granite, the diorite and the felsite appear in the form of intrusive dykes, which have burst through, tilted and transmuted the slates and sandstones, while the diorites and felsites have also intruded the granites. Some of the sedimentary rocks in the surveyed township are garnetiferous, and generally speaking, it may be said that the rocks over this area show great evidence of metamorphism. About two miles west of the main camp there is a low ridge upon which there is an outcrop of solid micaceous granite. A large lode of quartz with much tourmaline occurs here, and contiguous to it is a narrow belt of pure mica schist. There is another outcrop of solid micaceous granite about three and a half miles north of the main camp near the north-west corner of C.P. Portion 4—Gagie's Selection. In the granitic rocks hard white irregular shaped nodules of magnesite (carbonate of magnesia) are occasionally found.

Immediately underneath the two or three feet of Pleistocene clay which forms the surface of the plains decomposed granitic rocks occur; and herein is one of the most interesting features of the gold-field, for whereas the rocks forming the pine ridges are all of a very hard nature, the decomposed granitic rocks underlying the plains are so soft that no explosives are necessary for mining operations, and all the work of excavation has hitherto been easily done with the pick and shovel. These decomposed rocks are of various shades of grey, yellow, brown and red, and while some of them have evidently been micaceous granites, others are probably decomposed felsites and hornblendic granites, the brown or red colour being

This belt of slate, or a parallel one, extends through the surveyed township of Wyalong, and is surrounded by intrusive rocks, which have separated it from the main body of sedimentary rocks, the western boundary of which may be seen four or five miles to the eastwards.

Outlying Discoveries.—During my visit a rush occurred at a place called the Nine-mile, in the parish of Hiawatha, County of Gipps, about nine miles in a north-eastern direction from the main camp at Wyalong. Several reefs were discovered here, but very little work had been done upon them. One of these reefs (Gagie's Claim) showed good gold, but was cut off by a "fault," and they are now driving with the object of recovering the lost or "heaved" portion of the reef. This reef was also characterised by the occurrence of the nodules of limonite containing kernels of mispickel, which have already been described. The reefs at the Nine-mile Rush occur close to the junction of the main body of sedimentary rocks (just referred to), with decomposed granitic rocks similar to those at Wyalong. Gagie's Reef, and several others, are in the latter formation, but other reefs have also been found in the slate. A small patch of Tertiary drift (probably Pliocene), consisting of well-rounded pebbles of metamorphosed rocks, occurs on the side of a small ridge, at the Nine-mile Rush.

On Lange's Selection—Portion 11, Parish of Wyalong—about four miles north-west of the main camp, a vertical reef, having a width of four feet, has also been discovered in similar decomposed granitic rocks. I was informed by the owners, West and Party, that specimens showing gold had been taken down to Sydney from this reef, but on the occasion of my visit I could not see any. Comparatively little work has been done on this reef pending the granting of a permit to mine.

About two miles north-east of the surveyed township of Wyalong, a reef (the Little Darling) has been discovered by Barker and Party. This reef was six inches wide just beneath the surface, and showed good prospects. Here again, and for a further distance of at least two miles eastwards, the country consists of the same decomposed granitic rocks covered by Pleistocene clays.

About two miles to the south of Wyalong on George Bolte's Conditional Lease, Portion 21, Parish of Wyalong, is another reef showing good gold. This reef, which is being worked in the prospecting claim, by Bolte and Party, bears east 20° north, and dips north 20° west at an angle of about 44°. It is nearly three feet wide in places, and prospects well. The formation in which it occurs is again the same decomposed granitic rock.

Extent of Auriferous Area already prospected.—It will thus be seen that the area in which auriferous reefs have already been proved to exist in the same soft rock, extends for at least seven miles in a north and south direction, by a similar distance east and west. Only the central portion of this area—or about one square

mile—has been anything like systematically prospected; while the outlying discoveries, such as the Little Darling Reef on the extreme east, the Nine-mile Rush to the north-east, West and Party's reef on Lange's Selection to the north-west, and Bolte's Reef on Portion 21 to the south, appear to point to the probability of many other auriferous reefs existing within the area bounded by them.

Difficulties in the way of prospecting.—The outlying reefs just described must not be regarded as the ascertained boundaries of the gold-bearing area, but merely as the extreme limits to which prospecting had been carried at the time of my visit. The extremely level nature of the country, and the occurrence of continuous surface covering of Pleistocene clays, renders it a very difficult matter to define the limits of the auriferous area. In fact, it is only by digging costeaning trenches, or sinking shafts that the presence of reefs can be discovered; and hence it is that prospecting on this field becomes purely a matter of patient and careful work—there being little or no surface evidence to guide the miner.

Credit is undoubtedly due to the Neild family for the manner in which they have developed the field. They came there without any experience in mining and their success must be entirely attributed to their industry and determination. The method followed by them was to break and examine any fragment of quartz which they saw on the surface, and whenever they saw colours of gold in the stone, they sank through the two or three feet of clay or soil. In most instances they succeeded in finding the reef immediately below, and in this manner they have become the owners of some of the most promising reefs at Wyalong. Their example might be most advantageously followed by many men whom I saw on the field.

Conditions of Mining.—It has already been stated that with one exception (viz. where an auriferous reef occurs in slate country) the Wyalong reefs are found in decomposed granitic rocks, and these are so soft that no explosives are required for mining purposes. In addition to being very easily excavated, this decomposed rock appears to "hold" fairly well, or in other words, does not require a very great amount of support in the shape of timbering. It is evident, therefore, that at present the reefs are being worked under the most favourable conditions for economical mining.

The question as to the limit in depth to which these decomposed rocks may be expected to extend is one of considerable interest, as it will influence, in no small degree, the future of the field. In Taylor's Shaft, which at the time of my visit, had reached the depth of one hundred and seven feet, no perceptible difference could be observed in the character of the country rock, nor had the reef shown any alterations worthy of note, beyond the variations in width, which have already been alluded to as characteristics of all the reefs on the field. Moreover I was informed that in a shaft which had been sunk on a selection, four or five

miles distant from Wyalong, a depth of one hundred and ninety-two feet had been attained without striking water, and without getting below the limits of the decomposed granitic rocks. It may fairly be assumed, therefore, that the same favourable conditions as those under which the reefs are at present worked, will obtain to a depth of about two hundred feet. But on the other hand, there can be little doubt that the decomposed rock will eventually give place to hard granite, and when this is reached the cost of excavation will be a very much more expensive matter. In addition to this, when the hard rock is reached, it is probable that water will be met with to some extent, and the gold will be found (partly at any rate) in a more or less complex ore. Much of the gold showing at present has the appearance of having been set free by the decomposition of pyrites, and therefore it is fair to assume that below the water level, roasting and chlorination, or some analogous process will be required for its extraction from the sulphurous ores.

Possibility of Alluvial Deposits being found.—Mention has already been made of the level nature of the country at Wyalong and the covering up of its geological features by a uniform deposit of Pleistocene clays. Owing to these conditions, the discovery of old river valleys or alluvial deposits, is rendered even more difficult than the discovery of new reefs. Judging by the shafts already sunk, the bed-rock appears to come within a nearly uniform distance of the surface around the main camp, and there does not seem to be a very good prospect of alluvial drifts being discovered in the immediate vicinity. The field is, however, about eight hundred feet above sea level, and there is every reason, therefore, to expect that in Tertiary times the drainage from this area found its way into deep valleys, and deposited therein the gold which was derived from the denudation of the reefs. The search for these old valleys will probably require time and patience, but in the meanwhile it appears to me that one of the most likely looking outlets, viz., between the 16-Mile Tank and Doyle's Claim (south of the surveyed township), has been scarcely prospected.

Source of the Gold.—There is, I think, little doubt that the hornblendic rocks may be regarded as the immediate source of the gold at Wyalong. The hornblendic granites as well as the diorites, are probably of later age than the micaceous granites and sedimentary rocks which they have burst through in the form of dykes. These eruptive rocks when in a molten condition, probably carried a small proportion of gold from great depths, and it was subsequently leached from them and deposited in the reefs by the gradual percolation of thermal waters. The occurrence of such hornblendic rocks in proximity to gold-bearing reefs is characteristic of New South Wales gold-fields.

Up to the present date four hundred and eighty-eight tons of stone from Wyalong have been crushed for a total yield of eight hundred and sixty-nine ounces of smelted gold.

Summary.—In conclusion I may state that while the Wyalong reefs may all be expected to vary considerably in width, I can see no reason why they should not be persistent in depth. On the other hand at a depth of two hundred feet or thereabouts, the decomposed rocks in which the reefs are now being worked may be expected to give place to solid granite, and it is obvious that the cost of mining will then be materially increased, while the gold will probably be more difficult to extract.

In the meanwhile a considerable number of reefs have been proved to contain gold which should certainly be payable while the present conditions of mining obtain, and there seems to be every reason to suppose that the auriferous area will be considerably extended.

Preparations were being made for the erection of three batteries at Wyalong, when I left the field.

10th May, 1894.

8+9

PLATE VIII.

Oleandridium lentriculiforme, *Eth. fil.*

Fig. 1. An entire leaf, from Gosford.
Fig. 2. An incomplete leaf, from Freshwater.
Fig. 3. Portion of the neuration, magnified twice.

Drawn from nature by Mr. P. T. Hammond.

1

2

3

P. T. Hammond, del. Heliotype.

PLATE IX.

Fig. 1. Iguana, 3 feet 7 inches long.

Fig. 2. Imperfect outline, perhaps intended for a human figure, with bird-like head, &c.

Fig. 3. Possibly intended for a "Flying-fox" (*Pteropus*), or an Eagle-hawk, 3 feet 6 inches.

Fig. 4. Human leg, possibly the left, 2 feet.

Fig. 5. Female figure with upraised arms, but minus the feet; above the head is a heart-shaped body, 3 feet 5 inches.

Fig. 6. Emu, somewhat bent forward, 6 feet.

Fig. 7. Small bird possibly, of irregular proportions.

Fig. 8. Emu, smaller than Fig. 6, and in a more upright position, 3 feet 10 inches.

Fig. 9. Flying-squirrel (*Petaurus*), 2 feet 4 inches.

Fig. 10. Opossum probably, 4 feet 6 inches.

Fig. 11. Dilly-basket, 3 feet 9 inches.

Fig. 12. Echidna, 1 foot 6 inches.

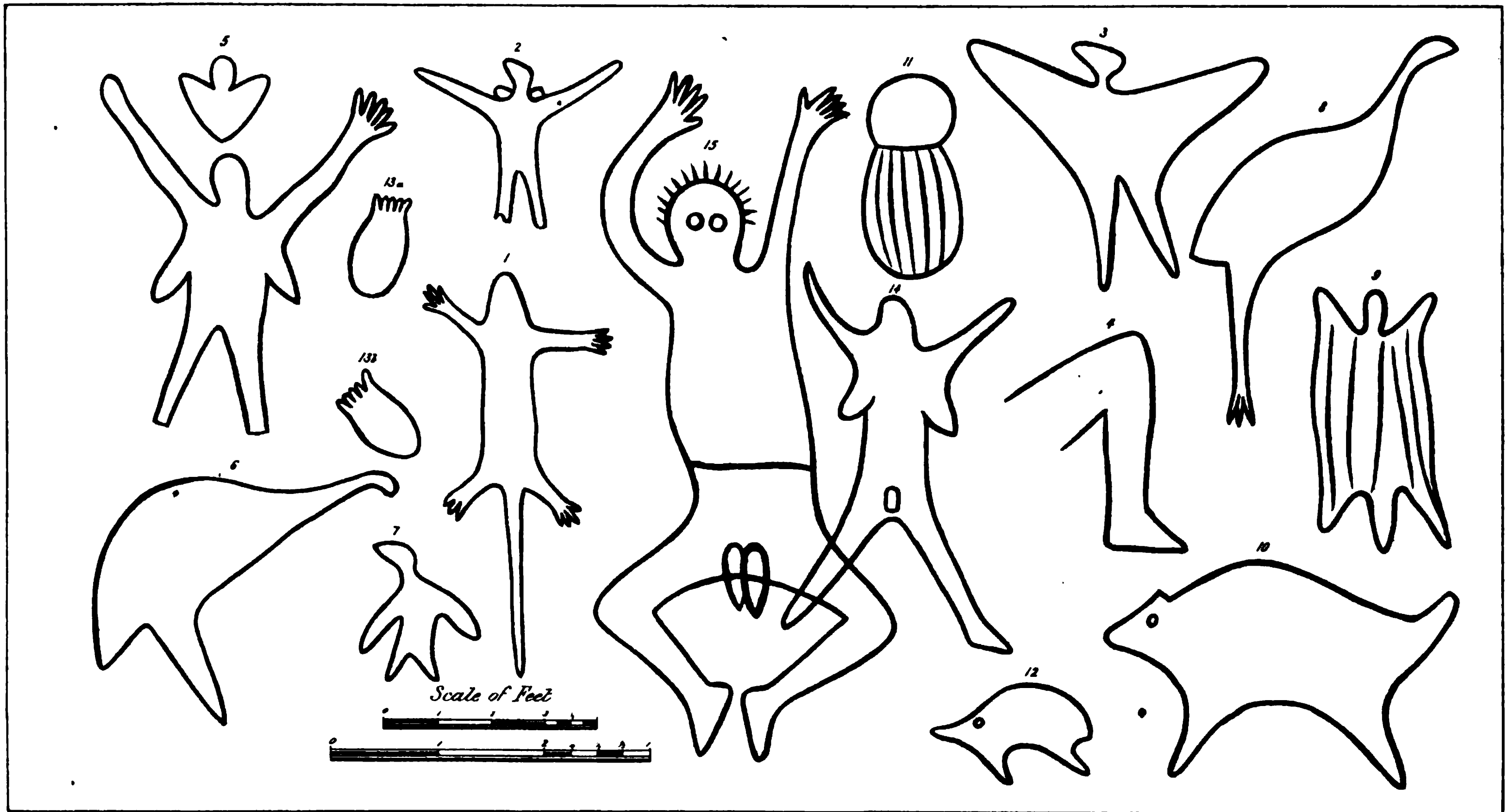
Fig. 13*a* and *b*. Foot-prints—Two of three impressions, 1 foot.

Fig. 14. Female figure, close to that of the male Fig. 15, 3 feet 6 inches.

Fig. 15. Male figure in the attitude of one of the magic dances, with head-dress, 6 feet 2 inches.

Drawn to scale, from nature, by Mr. G. H. Barrow.

PLATE IX.



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MINING DISTRICTS.

[illegible]rish, or part of.	Mining District.	Gold-field.
[illegible]rombie (part of)	Tumut and Adelong	Umaralla.
[illegible]ng (part of)	do do	Adelong Creek.
[illegible] do	Peel and Uralla	Swamp Oak and Niangala.
[illegible]	Mudgee	
[illegible]rt	Albert	Albert.
[illegible]ta	do	do
[illegible]	Tumut and Adelong	Black Range (partly).
[illegible]	Albert	Albert.
[illegible] (town of)	do	do
[illegible]	Peel and Uralla	Tingha.
[illegible]dale	New England	Emmaville (partly).
[illegible] (part of)	Bathurst	
[illegible]	New England	Boorook and Lunatic.
[illegible] (part of)	Bathurst	Caloola Creek (partly).
[illegible]	New England	Emmaville (partly).
[illegible]	Peel and Uralla	Tingha.
[illegible]	Hunter and Macleay	
[illegible]rrigarn	Albert	Albert.
[illegible]	Clarence and Richmond	Orara.
[illegible] Nobs	Peel and Uralla	
[illegible] (part of)	Tumut and Adelong	Molonglo (partly).
[illegible]dean	New England	
[illegible]	Clarence and Richmond	Tweed and Richmond Rivers (partly).
[illegible]amora	Tambaroora, and Turon, and Mudgee.	Turon River (partly).
[illegible]heet	Peel and Uralla	Bingara (partly).
[illegible] (part of)	do do	do do
[illegible]	Bathurst	Oberon.
[illegible] Downs	New England	Boorook and Lunatic.
[illegible]angee (part of)	Albert	Albert.
[illegible] (part of)	New England	Emmaville.
[illegible]	Bathurst	Beneree (partly).
[illegible]nee	Southern	Dromedary.
[illegible]	do	
[illegible]rre	do	
[illegible]	Hunter and Macleay	Barrington and Gloucester.
[illegible]	Peel and Uralla	Bingara.
[illegible] (part of)	do do	do
[illegible]	New England	Emmaville.
[illegible]neath	Bathurst	
[illegible]	New England	Emmaville.
[illegible]	Albert	Albert.
[illegible]me	Peel and Uralla	
[illegible]ara (part of).	Tambaroora and Turon.	Macquarie River, Stony Creek, and Ironbarks
[illegible] (part of)	do do	Wellington.
[illegible]	Albert	Albert.
[illegible]ah	Bathurst	Mulgunnia and Abercrombie.
[illegible]lah	Albert	Albert.

Parish, or part of.	Mining District.	Gold-field.
Bookookara (pt. of)	New England	Boorook and Lunatic.
Do do	do do	do do
Booloombayt	Hunter and Macleay	Gloucester.
Boona	Cobar	Bogan.
Do East	do	do
Do West	do	do
Boonoo Boonoo (pt. of).	New England	Boorook and Lunatic.
Boorook	do do	do do
Boranel	Hunter and Macleay	Gloucester.
Bowman	New England	Emmaville.
Boyd	Peel and Uralla	
Brangalgan	Tumut and Adelong	Bourke, Cooper, Dowling, and Gipps.
Branxton	Hunter and Macleay	
Bray	Albert	Albert.
Bringellet (part of).	Bathurst	Caloola Creek.
Broadmeadows	Clarence and Richmond	Boyd or Little River.
Broulee (& Tomago)	Southern	Mogo (partly).
Brundah	Lachlan	Tyagong Creek.
Buangla (part of)	Southern	Yalwal.
Bullongong do	Tumut and Adelong	Molonglo (partly).
Bumbaldry	Lachlan	Tyagong Creek.
Bundar	New England	Emmaville (partly).
Bundawarrah	Lachlan	Temora (partly).
Do (part of)	do	do do
Burke	Southern	
Burra	Cobar	Bogan.
Burrandong	Tambaroora and Turon.	Macquarie River, Stony Creek, Ironbarks, and Wellington.
Do (part of)	do do	Macquarie River, Stony Creek, and Ironbarks.
Burrill	Lachlan	Bogan.
Byjerkerno	Albert	Albert.
Byng	Bathurst	Byng (partly).
Byngrano	Albert	Albert.
Cadger	Southern	Gulph (partly).
Calafat	Tumut and Adelong	Adelong Creek.
Callanyn (part of)	New England	Boorook and Lunatic.
Caloola (part of)	Albert	Albert.
Canowindra	Bathurst	Canowindra (partly).
Carroll (part of)	Tambaroora and Turon.	Wellington.
Cargo	Lachlan	Cargo and Canowindra.
Do (part of)	do	Cargo.
Castleton	Bathurst	Turon River and Kirkconnell.
Cataract (part of)	New England	Boorook and Lunatic (partly).
Cathcart	Albert	Albert.
Cavendish	New England	Timbarra and Boorook and Lunatic.
Cessnock	Hunter and Macleay	

Parish, or part of.	Mining District.	Gold-field.
Chalmers (part of)	Peel and Uralla	Upper Hunter (partly).
Churchill do	New England	Solferino.
Clare	Peel and Uralla	Tingha.
Clarence (part of)	New England	Tooloom Creek.
Clifford do	Tumut and Adelong	Umaralla.
Clinton	Bathurst	Ophir
Clive	Peel and Uralla	Tingha.
Coally (part of)	Albert	Albert.
Cobar	Cobar	Bogan.
Cole (part of)	Bathurst	Newbridge (partly).
Collett	Lachlan	Canowindra.
Colongon	New England	Boorook and Lunatic.
Coolaroi	Clarence and Richmond	Orara.
Coola	Bathurst	
Coolamin	Tambaroora and Turon	Macquarie River, Stoney Creek, and Ironbarks.
Coolamigal	Bathurst	Turon River.
Coonbaralba	Albert	Albert.
Cooney	Peel and Uralla	Gyra River.
Do (part of)	do do	do
Coorumbung	Hunter and Macleay	
Cope's Creek	Peel and Uralla	Tingha.
Corella	Cobar	Bogan.
Conleaux	Southern	
Corona	Albert	Albert.
Corry (part of)	New England	Boorook and Lunatic.
Coventry	Peel and Uralla	Kookarabooka.
Cox	Bathurst	
Cranbrook (part of)	New England	Emmaville.
Craven	Hunter and Macleay	Gloucester.
Cullen Bullen	Bathurst	Turon River (partly).
Cullendore	New England	
Cummings (part of)	Tambaroora and Turon	Wellington.
Curragurra do	do do	Macquarie River, Stony Creek and Ironbarks.
Currajong do	Lachlan	Billabong.
Currambene	Southern	Cooloongatta (partly).
Curreeki	Hunter and Macleay	Gloucester.
Dalmorton (part of)	Clarence and Richmond.	Boyd or Little River.
Danjerra do	Southern	Yalwal.
Darby	Peel and Uralla	Tingha.
Derra Derra	do do	Bingara (partly).
Do (part of)	do do	do do
Dering	Albert	Albert.
Dhoon	do	do
Digby	Peel and Uralla	
Dinoga	do do	Bingara.
Do (part of)	do do	do
Dumaresq	New England	Emmaville.
Dungowan	Peel and Uralla	Peel River.
Dunleary (part of)	Bathurst	Milburn Creek.
Edgar	Albert	Albert.
Ellerslie	Cobar	Bogan.
Elsmore	Peel and Uralla	Tingha (partly).
Enmore	Albert	Albert.
Do	Peel and Uralla	Gyra River Extension.
Eskdale	Bathurst	Clear Creek and Kirkconnell (partly).
Ettrema	Southern	Yalwal.
Euadera (part of)	Tumut and Adelong	Adelong Creek (partly).
Emmur	Peel and Uralla	Ironbarks and Tea-tree.
Ensdale	Bathurst	Kirkconnell and Mount Lambie (partly).
Fairy Hill	Albert	Albert.
Falnash	Bathurst	Turon River (partly).
Fitzroy	Cobar	Bogan.
Flagstone	New England	Emmaville.
Forbes	Lachlan	Billabong and Lachlan, Wellington, Macquarie River.
Do (part of)	Bathurst	Stony Creek, Ironbarks, and Ophir.
Fowler's Gap do	Albert	Albert.
Freemantle do	Bathurst	Ophir (partly).
Frazer	New England	Emmaville.
Do	do	
Gadara (part of)	Tumut and Adelong	Adelong Creek (partly).
Gairdner's Creek	Albert	Albert.
Galbraith	Bathurst	Newbridge and Caloola Creek (partly).
Do (part of)	do	Newbridge (partly).
Gibraltar do	New England	

Parish, or part of.	Mining District.	Gold-field.
Giles (part of)	Albert	Albert.
Gilgurry do	New England	Boorook and Lunatic.
Gillenbine	Cobar	Bogan.
Gillindich	Bathurst	Junction Point, Tuena Creek, and Markdale.
Glenken	Tumut and Adelong	Ourance Creek.
Gneupa	Southern	Pambula.
Gooloongolok	Hunter and Macleay	Gloucester.
Gordon	Peel and Uralla	
Gouron (part of)	do do	Bingara.
Greme	Hunter and Macleay	Nowendock and Gloucester.
Gulgong	Mudgee	Gulgong.
Gulph (part of)	Southern	Gulph (partly).
Guntawang	Mudgee	Gulgong.
Hall	Peel and Uralla	Kookarabooka.
Do	do	Ironbark and Tea-tree.
Do	do	Bingara (partly).
Do (part of)	do	do
Hamilton	New England	Emmaville (partly).
Hampton	Bathurst	Belubula do
Hanning	Peel and Uralla	
Hargraves	Mudgee	Wellington.
Hartley	Bathurst	
Haystack	New England	Emmaville.
Heathcote	Southern	
Herbert	Peel and Uralla	Tingha.
Herborn	Hunter and Macleay	Orara.
Highland Home	New England	Emmaville.
Hughes	Albert	Albert.
Ironbarks (part of)	Tambaroora and Turon.	Macquarie River, Stony Creek, Ironbarks, and Muckerawa.
Inverary	Southern	Nerrimunga.
Inverell	Peel and Uralla	
Jamberoo	Southern	
Jamieson	Bathurst	
Jallore	Southern	
Jarricknorra	do	Shoalhaven and Shoalhaven River (partly).
Jingellic East	Tumut and Adelong	Ourance Creek.
Jounja	Southern	
Jocelyn	Bathurst	Oberon.
Kahibah	Hunter and Macleay	
Kangaloon	Southern	
Kedumba	Bathurst	
Kembla	Southern	
Kirk	Albert	Albert.
Lake Macquarie	Hunter and Macleay	
Land's End	New England	Emmaville.
Langdale (part of)	Bathurst	Oberon (partly)
Lennox	do	Ophir do
Lewis	Albert	Albert.
Do (part of)	Bathurst	Ophir (partly).
Lidsdale	do	Mount Lambie (partly).
Loftus (part of)	Peel and Uralla	Swamp Oak and Niangala (partly).
Macintyre (part of)	do do	Bingara (partly).
Maharatta	Albert	Albert.
Mandamah (part of)	Lachlan	Barmedman (partly).
Mandolong	Hunter and Macleay	
Manildra	Lachlan	Dilga.
Marangaroo	Bathurst	
March (part of)	do	Ophir.
Marsh	New England	
Martin	Lachlan	Billabong.
Marulan	Southern	Argyle, Camden, and [illegible]
Maryland	New England	
Mayo	Peel and Uralla	Tingha.
Megalong	Bathurst	
Merrigalah (part of)	Peel and Uralla	Gyra River.
Metz	do do	do
Do (part of)	do do	do
Mickimill	Cobar	Bogan.
Milring (part of)	Albert	Albert.
Mingelo do	Mudgee	Tomingley.
Mitchell	Peel and Uralla	
Do (part of)	do do	Kookabookra and Oban.
Molroy	do do	Bingara.
Mongarlowe	Southern	Mongarlowe River (partly).
Moonan (part of)	Peel and Uralla	Upper Hunter.
Moorkaie	Albert	Albert.
Moquilamba	Cobar	Bogan.

MINING DISTRICTS—*continued.*

arish, or part of.	Mining District.	Gold-field.
uya	Southern	Moruya (partly).
ndurey	Mudgee	
un	Bathurst	
nt Allen	Cobar	Bogan.
nt Gipps	Albert	Albert.
nt Hope	Cobar	Bogan.
kerwa (part of)	Tambaroora and Turon.	Macquarie River, Stony Creek, Ironbarks, and Muckerwa.
Do do	do do	do do
gincoble	Lachlan	Billabong.
ar	New England	Emmaville.
lgunnia	Bathurst	Mulgunnia and Abercrombie (partly).
ndi Mundi	Albert	Albert.
gabarina	Tumut and Adelong	Black Range (partly).
rga	Cobar	Bogan.
all	Peel and Uralla	Bingara.
nock	Albert	Albert.
radin	do	do
rrangarril	Southern	Argyle, Camden, and King.
ean	Bathurst	
rigundah (part of)	Southern	Gulph (partly).
rrimunga	do	Nerrimungah Creek.
New England Mining District.		
wry	Peel and Uralla	Ironbark and Tea-tree (partly).
Do	Hunter and Macleay	Orara.
orroma	Southern	Dromedary.
Do (part of)	do	do
otumbulla do	Albert	Albert.
llama	Clarence and Richmond	Boyd or Little River (partly).
ndle (part of)	Peel and Uralla	Peel River (partly).
llum	Clarence and Richmond	Tweed and Richmond Rivers.
allen (part of)	Southern	Shoalhaven and Shoalhaven River.
Oberon	Bathurst	Oberon.
castle (part of)	Peel and Uralla	Upper Hunter.
ney	Hunter and Macleay	
adale	Peel and Uralla	Upper Hunter.
mara	Albert	Albert.
ton	Southern	Argyle, Camden, and King.
r (part of), Mount Brown.	Albert	Albert.
Pampara	do	do
Para	do	do
Paradise North	New England	Emmaville.
Parkes	Lachlan	Billabong.
Picton	Albert	Albert.
Prospero (part of)	Peel and Uralla	Upper Hunter
mamoota	Albert	Albert.
rvis (part of)	New England	Emmaville.
R id do	do do	Boorook and Lunatic
Robe	Albert	Albert.
Rock Glen	New England	Emmaville.
Rockvale	do do	do
Romney (part of)	do do	do
Rose Valley do	Tumut and Adelong	Umaralla.
Ruby	New England	Boorook and Lunatic (partly).
den	Peel and Uralla	
Sara (part of)	do do	Kookarabooka.
Do do	do do	do
Sarsfield	Cobar	Bogan.
ne	Peel and Uralla and New England.	Emmaville (partly).
Scott	Peel and Uralla	
Sebastopol	Tumut and Adelong	Sebastopol, Junee, and Urangilly (partly).
Do	Albert	Albert.
Seeley (part of)	Peel and Uralla	Kookarabooka.
Sentinel	Albert	Albert.
Severn (part of)	Peel and Uralla	
Silent Grove (pt. of).	New England	Emmaville (partly).
Single	Peel and Uralla	Tingha do
Sofala	Tambaroora and Turon.	Turon River.
Somers (part of)	Bathurst	Gully Swamp and Black Hills (partly).
Somerset	Cobar	Bogan.
Soudan	Albert	Albert.
Southend	Southern	
South Gundagai	Tumut and Adelong	Adelong Creek and Gundagai.

Parish, or part of.	Mining District.	Gold-field.
Springbrook	Clarence and Richmond	Boyd or Little River.
Stanford	Hunter and Macleay	
Stephen	Albert	Albert.
Stockington	Hunter and Macleay Extended.	
Stockton	Hunter and Macleay	
Do (town of)	do do	
Stonehenge	Peel and Uralla	
Stowell	Hunter and Macleay	
Strachan	New England	Emmaville (partly).
Strathbogie	do do and Peel and Uralla.	do do
Do North	New England	do do
Strathspey (part of)	do do	Boorook and Lunatic.
Sutton	Hunter and Macleay	
Swinton	Peel and Uralla	Tingha.
Talbragar	Mudgee	Gulgong.
Tallaganda (part of)	Southern	
Tambaroora do	Tambaroora and Turon.	Wellington.
Tara	Albert	Albert.
Teleraree	Hunter and Macleay	Gloucester (partly).
Tenandra	Mudgee	Mitchell's Creek.
Tent Hill	New England	Emmaville (partly).
Teralba	Hunter and Macleay	
Thornshope	Bathurst	Mount Lambie.
Tienga	Peel and Uralla	
Timbarra	New England	Boorook and Lunatic, and Timbarra.
Tomago	Southern	Mogo (partly).
Tomaree	Hunter and Macleay	
Toogong	Lachlan	Cargo and Canowindra (partly.
Topi Topi	Hunter and Macleay	Gloucester.
Torrorwangee	Albert	Albert.
Torrens (part of)	Bathurst	King's Plains.
Tont	Cobar	Bogan.
Trianbil (part of)	Tambaroora and Turon.	Wellington.
Trigalong	Lachlan	Temora.
Tuena	Bathurst	Abercrombie.
Tuggarah	Hunter and Macleay	
Tumbarumba	Tumut and Adelong	Tumbarumba, Ouranee, and Burra Creek (partly).
Undercliff (part of)	New England	Boorook and Lunatic.
Undoo do	Tumut and Adelong	
Umberumberka	Albert	Albert.
Ulmarrah (part of)	Tambaroora and Turon.	Wellington.
Urobodalla do	Southern	
Walcha	Peel and Uralla	Swamp Oak and Niangala.
Wallah Wallah	Lachlan	Lachlan.
Wallundry	do	Gundabindyal.
Walters (part of)	Tambaroora and Turon.	Wellington.
Wangat	Hunter and Macleay	Gloucester.
Warragamba	Bathurst	
Warratra (part of)	Mudgee	Wellington.
Warre Warral	Tumut and Adelong	Sebastopol, Junee, and Urangilly.
Waukaroo	Albert	Albert.
Wellington North	New England	Emmaville (partly).
Wellington Vale	do do	do do
Wells	Tambaroora and Turon.	
Wertago	Albert	Albert.
West Fairfield	New England	Timbarra.
Willie Ploma	Tumut and Adelong	Adelong Creek.
Willyama, (village of)	Albert	Albert.
Windeyer (part of)	Mudgee	Wellington.
Wonona	Southern	
Wongawilli	do	
Wood's Reef	Peel and Uralla	Iron-bark and Tea-tree.
Woraro	Albert	Albert.
Worcester	Bathurst	Ophir.
Worra	Peel and Uralla	Kookarabooka.
Wyaldra	Mudgee	Gulgong.
Wyanbene	Southern	
Wylie	New England	Boorook and Lunatic (partly).
Yalwal (part of)	Southern	Yalwal.
Yancowinna	Albert	Albert.
Do North	do	do
Yarralaw	Southern	Argyle, Camden, and King.
Young (part of)	Lachlan	Burrangong.
Yowaka	Southern	Pambula.
Do (part of)	do	do

Parish, or part of.	Mining District.	Gold-field.
Chalmers (part of)	Peel and Uralla	Upper Hunter (partly).
Churchill do	New England	Solferino.
Clare	Peel and Uralla	Tingha.
Clarence (part of)	New England	Tooloom Creek.
Clifford do	Tumut and Adelong	Umaralla.
Clinton	Bathurst	Ophir
Clive	Peel and Uralla	Tingha.
Coolly (part of)	Albert	Albert.
Cobar	Cobar	Bogan.
Cole (part of)	Bathurst	Newbridge (partly).
Collett	Lachlan	Canowindra.
Colongon	New England	Boorook and Lunatic.
Comlaroi	Clarence and Richmond	Orara.
Cooba	Bathurst	
Coolamin	Tambaroora and Turon	Macquarie River, Stoney Creek, and Ironbarks.
Coolamigal	Bathurst	Turon River.
Coontaralba	Albert	Albert.
Cooney	Peel and Uralla	Gyra River.
Do (part of)	do do	do
Coorumbung	Hunter and Macleay	
Cope's Creek	Peel and Uralla	Tingha.
Cordila	Cobar	Bogan.
Cordeaux	Southern	
Corona	Albert	Albert.
Corry (part of)	New England	Boorook and Lunatic.
Coventry	Peel and Uralla	Kookarabooka.
Cox	Bathurst	
Cranbrook (part of)	New England	Emmaville.
Craven	Hunter and Macleay	Gloucester.
Cullen Bullen	Bathurst	Turon River (partly).
Cullendore	New England	
Cummings (part of)	Tambaroora and Turon	Wellington.
Curragurra do	do do	Macquarie River, Stony Creek and Ironbarks.
Currajong do	Lachlan	Billabong.
Currambene	Southern	Cooloongatta (partly).
Curreeki	Hunter and Macleay	Gloucester.
Dalmorton (part of)	Clarence and Richmond	Boyd or Little River.
Danjerra do	Southern	Yalwal.
Darby	Peel and Uralla	Tingha.
Derra Derra	do do	Bingara (partly).
Do (part of)	do do	do do
Dering	Albert	Albert.
Dhoon	do	do
Dugloy	Peel and Uralla	
Dinoga	do do	Bingara.
Do (part of)	do do	do
Dumaresq	New England	Emmaville.
Dungowan	Peel and Uralla	Peel River.
Dunleary (part of)	Bathurst	Milburn Creek.
Edinas	Albert	Albert.
Ellerslie	Cobar	Bogan.
Elsmore	Peel and Uralla	Tingha (partly).
Enmore	Albert	Albert.
Do	Peel and Uralla	Gyra River Extension.
Eskdale	Bathurst	Clear Creek and Kirkconnell (partly).
Ettrema	Southern	Yalwal.
Euadera (part of)	Tumut and Adelong	Adelong Creek (partly).
Eumur	Peel and Uralla	Ironbarks and Tea-tree.
Evesdale	Bathurst	Kirkconnell and Mount Lambie (partly).
Fairy Hill	Albert	Albert.
Falnash	Bathurst	Turon River (partly).
Fitzroy	Cobar	Bogan.
Flagstone	New England	Emmaville.
Forbes	Lachlan	Billabong and Lachlan, Wellington, Macquarie River.
Do (part of)	Bathurst	Stony Creek, Ironbarks, and Ophir.
Fowler's Gap do	Albert	Albert.
Freemantle do	Bathurst	Ophir (partly).
Fraser	New England	Emmaville.
Do	do	
Gadara (part of)	Tumut and Adelong	Adelong Creek (partly).
Gairdner's Creek	Albert	Albert.
Galbraith	Bathurst	Newbridge and Caloola Creek (partly).
Do (part of)	do	Newbridge (partly).
Gibraltar do	New England	

Parish, or part of.	Mining District.	Gold-field.
Giles (part of)	Albert	Albert.
Gillgurry do	New England	Boorook and Lunatic.
Gillenbine	Cobar	Bogan.
Gillindich	Bathurst	Junction Point, Tuena [illegible] and Markdale.
Glenken	Tumut and Adelong	Gilmore Creek.
Gneupa	Southern	Pambula.
Gooloongolok	Hunter and Macleay	Gloucester.
Gordon	Peel and Uralla	
Gouron (part of)	do do	Bingara.
Graeme	Hunter and Macleay	Nowendoc and Gloucester.
Gulgong	Mudgee	Gulgong.
Gulph (part of)	Southern	Gulph (partly).
Guntawang	Mudgee	Gulgong.
Hall	Peel and Uralla	Kookarabooka.
Do	do	Ironbark and Tea-tree.
Do	do	Bingara (partly).
Do (part of)	do	do
Hamilton	New England	Emmaville (partly).
Hampton	Bathurst	Belubula do
Hanning	Peel and Uralla	
Hargraves	Mudgee	Wellington.
Hartley	Bathurst	
Haystack	New England	Emmaville.
Heathcote	Southern	
Herbert	Peel and Uralla	Tingha.
Herborn	Hunter and Macleay	Orara.
Highland Home	New England	Emmaville.
Hughes	Albert	Albert.
Ironbarks (part of)	Tambaroora and Turon	Macquarie River, Stony Creek, Ironbarks, and [illegible]
Inverary	Southern	Nerrimunga.
Inverell	Peel and Uralla	
Jamberoo	Southern	
Jamieson	Bathurst	
Jallore	Southern	
Jarricknorra	do	Shoalhaven and [illegible] River (partly).
Jingellic East	Tumut and Adelong	Gilmore Creek.
Joadja	Southern	
Jocelyn	Bathurst	Oberon.
Kahibah	Hunter and Macleay	
Kangaloon	Southern	
Kedumba	Bathurst	
Kembla	Southern	
Kirk	Albert	Albert.
Lake Macquarie	Hunter and Macleay	
Land's End	New England	Emmaville.
Langdale (part of)	Bathurst	Oberon (partly).
Lennox	do	Ophir do
Lewis	Albert	Albert.
Do (part of)	Bathurst	Ophir (partly).
Lidsdale	do	Mount Lambie (partly).
Loftus (part of)	Peel and Uralla	Swamp Oak and [illegible] (partly).
Macintyre (part of)	do do	Bingara (partly).
Maharatta	Albert	Albert.
Mandamah (part of)	Lachlan	Barmedman (partly).
Mandolong	Hunter and Macleay	
Manildra	Lachlan	Dilga.
Marangaroo	Bathurst	
March (part of)	do	Ophir.
Marsh	New England	
Martin	Lachlan	Billabong.
Marulan	Southern	Argyle, Camden, and [illegible]
Maryland	New England	
Mayo	Peel and Uralla	Tingha.
Megalong	Bathurst	
Merrigalah (part of)	Peel and Uralla	Gyra River.
Metz	do do	do
Do (part of)	do do	do
Mickimill	Cobar	Bogan.
Milring (part of)	Albert	Albert.
Mingelo do	Mudgee	Tomingley.
Mitchell	Peel and Uralla	
Do (part of)	do do	Kookabookra and [illegible]
Molroy	do do	Bingara.
Mongarlowe	Southern	Mongarlowe River (partly).
Moonam (part of)	Peel and Uralla	Upper Hunter.
Moorkale	Albert	Albert.
Moquilambo	Cobar	Bogan.

MINING DISTRICTS—*continued.*

[illegible], or part of.	Mining District.	Gold-field.
[illegible]	Southern	Moruya (partly).
[illegible]	Mudgee	
[illegible]	Bathurst	
[illegible]	Cobar	Bogan.
[illegible]	Albert	Albert.
[illegible]	Cobar	Bogan.
[illegible] (part of)	Tambaroora and Turon.	Macquarie River, Stony Creek, Ironbarks, and Muckerwa.
Do do	do do	do do
[illegible]	Lachlan	Billabong.
[illegible]	New England	Emmaville.
[illegible]	Bathurst	Mulgunnia and Abercrombie (partly).
[illegible]	Albert	Albert.
[illegible]	Tumut and Adelong	Black Range (partly).
[illegible]	Cobar	Bogan.
[illegible]	Peel and Uralla	Bingara.
[illegible]	Albert	Albert.
[illegible]	do	do
[illegible]	Southern	Argyle, Camden, and King.
[illegible]	Bathurst	
[illegible] (part of)	Southern	Gulph (partly).
[illegible]	do	Nerrimungah Creek.
[illegible] Mining District.		
[illegible]	Peel and Uralla	Ironbark and Tea-tree (partly).
Do	Hunter and Macleay	Orara.
[illegible]	Southern	Dromedary.
Do (part of).	do	do
[illegible] do	Albert	Albert.
[illegible]	Clarence and Richmond	Boyd or Little River (partly).
[illegible] (part of)	Peel and Uralla	Peel River (partly).
[illegible]	Clarence and Richmond	Tweed and Richmond Rivers.
[illegible] (part of)	Southern	Shoalhaven and Shoalhaven River.
[illegible]	Bathurst	Oberon.
[illegible] (part of)	Peel and Uralla	Upper Hunter.
[illegible]	Hunter and Macleay	
[illegible]	Peel and Uralla	Upper Hunter.
[illegible]	Albert	Albert.
[illegible]	Southern	Argyle, Camden, and King.
[illegible] (part of), Mount [illegible]	Albert	Albert.
[illegible]	do	do
[illegible]	do	do
[illegible] North	New England	Emmaville.
[illegible]	Lachlan	Billabong.
[illegible]	Albert	Albert.
[illegible] (part of)	Peel and Uralla	Upper Hunter
[illegible]	Albert	Albert.
[illegible] (part of)	New England	Emmaville.
[illegible] do	do do	Boorook and Lunatic
[illegible]	Albert	Albert.
[illegible] Glen	New England	Emmaville.
[illegible]	do do	do
[illegible] (part of)	do do	do
[illegible] Valley do	Tumut and Adelong	Umaralla.
[illegible]	New England	Boorook and Lunatic (partly).
[illegible]	Peel and Uralla	
[illegible] (part of)	do do	Kookarabooka.
[illegible] do	do do	do
[illegible]	Cobar	Bogan.
[illegible]	Peel and Uralla and New England.	Emmaville (partly).
[illegible]	Peel and Uralla	
[illegible]	Tumut and Adelong	Sebastopol, Junee, and Urangilly (partly).
[illegible]	Albert	Albert.
[illegible] (part of)	Peel and Uralla	Kookarabooka.
[illegible]	Albert	Albert.
[illegible] (part of)	Peel and Uralla	
[illegible] Grove (pt. of)	New England	Emmaville (partly).
[illegible]	Peel and Uralla	Tingha do
[illegible]	Tambaroora and Turon.	Turon River.
[illegible] (part of)	Bathurst	Gully Swamp and Black Hills (partly).
[illegible]	Cobar	Bogan.
[illegible]	Albert	Albert.
[illegible]	Southern	
[illegible] Gundagai	Tumut and Adelong	Adelong Creek and Gundagai.

Parish, or part of.	Mining District.	Gold-field.
Springbrook	Clarence and Richmond	Boyd or Little River.
Stanford	Hunter and Macleay	
Stephen	Albert	Albert.
Stockington	Hunter and Macleay Extended.	
Stockton	Hunter and Macleay	
Do (town of)	do do	
Stonehenge	Peel and Uralla	
Stowell	Hunter and Macleay	
Strachan	New England	Emmaville (partly).
Strathbogie	do do and Peel and Uralla.	do do
Do North	New England	do do
Strathspey (part of)	do do	Boorook and Lunatic.
Sutton	Hunter and Macleay	
Swinton	Peel and Uralla	Tingha.
Talbragar	Mudgee	Gulgong.
Tallaganda (part of)	Southern	
Tambaroora do	Tambaroora and Turon.	Wellington.
Tara	Albert	Albert.
Teleraree	Hunter and Macleay	Gloucester (partly)
Tenandra	Mudgee	Mitchell's Creek.
Tent Hill	New England	Emmaville (partly).
Teralba	Hunter and Macleay	
Thornshope	Bathurst	Mount Lambie.
Tienga	Peel and Uralla	
Timbarra	New England	Boorook and Lunatic, and Timbarra.
Tomago	Southern	Mogo (partly).
Tomaree	Hunter and Macleay	
Toogong	Lachlan	Cargo and Canowindra (partly).
Topi Topi	Hunter and Macleay	Gloucester.
Torrowangee	Albert	Albert.
Torrens (part of)	Bathurst	King's Plains.
Tont	Cobar	Bogan.
Triamble (part of)	Tambaroora and Turon.	Wellington.
Trigalong	Lachlan	Temora.
Tuena	Bathurst	Abercrombie.
Tuggarah	Hunter and Macleay	
Tumbarumba	Tumut and Adelong	Tumbarumba, Ournie, and Burra Creek (partly).
Undercliff (part of)	New England	Boorook and Lunatic.
Undoo do	Tumut and Adelong	
Umbarumberka	Albert	Albert.
Ulmarrah (part of)	Tambaroora and Turon.	Wellington.
Urobodalla do	Southern	
Walcha	Peel and Uralla	Swamp Oak and Niangala.
Wallah Wallah	Lachlan	Lachlan.
Wallundry	do	Gundabindyal.
Walters (part of)	Tambaroora and Turon.	Wellington.
Wangat	Hunter and Macleay	Gloucester.
Warragamba	Bathurst	
Warratra (part of)	Mudgee	Wellington.
Warre Warral	Tumut and Adelong	Sebastopol, Junee, and Urangilly.
Watikaroo	Albert	Albert.
Wellington North	New England	Emmaville (partly).
Wellington Vale	do do	do do
Wells	Tambaroora and Turon.	
Wertago	Albert	Albert.
West Fairfield	New England	Timbarra.
Willie Ploma	Tumut and Adelong	Adelong Creek.
Willyama, (village of)	Albert	Albert.
Windeyer (part of)	Mudgee	Wellington.
Wonuma	Southern	
Wongawilli	do	
Wood's Reef	Peel and Uralla	Iron-bark and Tea-tree.
Woraro	Albert	Albert.
Worcester	Bathurst	Ophir.
Worra	Peel and Uralla	Kookarabooka.
Wyaldra	Mudgee	Gulgong.
Wyanbene	Southern	
Wylie	New England	Boorook and Lunatic (partly).
Yalwal (part of)	Southern	Yalwal.
Yancowinna	Albert	Albert.
Do North	do	do
Yarralaw	Southern	Argyle, Camden, and King.
Young (part of)	Lachlan	Burrangong.
Yowaka	Southern	Pambula.
Do (part of)	do	do

GEOLOGICAL MAPS AND PUBLICATIONS ISSUED BY THE DEPARTMENT OF MINES AND AGRICULTURE, SYDNEY.

(1.) MAPS.

Map showing Mineral Areas of New South Wales. Scale, 16 miles to 1 inch.
Do do do Scale, 50 miles to 1 inch.
Geological Sketch Map of New South Wales, compiled from the Maps of the late Rev. W. B. Clarke, M.A., F.R.S., by C. S. Wilkinson, L.S., F.G.S., Government Geological Surveyor-in-charge. Scale, 8 miles to 1 inch.
Do do do do Scale, 22 miles to 1 inch.
Do do do prepared under the direction of E. F. Pittman, &c., &c., Government Geologist. Scale, 16 miles to 1 inch.
Geological Map of the Districts of Hartley, Bowenfells, Wallerawang, and Rydal, by C. S. Wilkinson, L.S., F.G.S.
Geological Map of Hill End and Tambaroora, by E. F. Pittman, Geological Surveyor.
Geological Map of the Vegetable Creek Tin-mining District, by T. W. E. David, B.A., F.G.S., Geological Surveyor. Scale, 58 chains to 1 inch.
Index Map of the Vegetable Creek Tin-fields, by T. W. E. David, B.A., F.G.S. Scale, 80 chains to 1 inch.
Geological Map of the Forest Reefs District, by H. Y. L. Brown, Geological Surveyor.
Map of the Silver-mining Country, Barrier Ranges, by C. S. Wilkinson, L.S., F.G.S.
Vertical Sections of New South Wales Upper Coal Measures, by John Mackenzie, F.G.S., Examiner of Coal-fields.
Diagrams showing the Thickness, Character, and Portion mined out of Coal-seams in the Coal Measures of New South Wales, by John Mackenzie, F.G.S., Examiner of Coal-fields.
Plans showing the Outcrop, Thickness, and Dip of the Coal-seams in the Northern, Southern, and Western Coal-mining Districts of New South Wales, by John Mackenzie, F.G.S., Examiner of Coal-fields.
Geological Sketch Map showing boundary of the Cretaceo-Tertiary Formation in the County of Cowper, by William Anderson, Geological Surveyor, 1889.
Geological Sketch Map of Tertiary Deep Lead, Tumberumba, by William Anderson, 1890.
Sketch Map showing Geological Features between Peak Hill and Tomingley, by William Anderson, 1890.

(2.) PUBLICATIONS.

The Mining Act of 1881, with Regulations.
Annual Reports from 1875 to 1893 inclusive.
Mines and Mineral Statistics, 1875. [Out of print.]

Mineral Products of New South Wales, 1882, containing:—
1. Mineral Products of New South Wales, by Harrie Wood, J.P., Under Secretary for Mines.
2. Notes on the Geology of New South Wales, by C. S. Wilkinson, L.S., F.G.S., Geological Surveyor-in-Charge.
3. Description of the Minerals of New South Wales, by Archibald Liversidge, M.A., F.R.S., F.C.S., F.G.S., &c., Professor of Chemistry and Mineralogy in the University of Sydney.
4. Catalogue of Works, Papers, Reports, and Maps on the Geology, Palæontology, Mineralogy, &c., &c., of the Australian Continent and Tasmania, by Robert Etheridge, Junr., of the British Museum, and Robert Logan Jack, F.R.G.S., F.G.S., Government Geologist for Queensland.

Mineral Products of New South Wales, 2nd Edition, 1886, containing:— [Out of print.]
1. Mineral Products of New South Wales, by Harrie Wood, J.P., Under Secretary for Mines.
2. Notes on the Geology of New South Wales, by C. S. Wilkinson, L.S., F.G.S., Geological Surveyor-in-Charge.
3. The Collieries and Boghead Mineral Mines of New South Wales, by John Mackenzie, F.G.S., Examiner of Coal Fields.

Memoirs of the Geological Survey of New South Wales.

Geology.
1. Report on the Vegetable Creek Tin Mining District, by T. W. E. David, B.A., F.G.S., Geological Surveyor.
5. Geology of the Broken Hill Lode and Barrier Ranges Mineral Field, New South Wales, by J. B. Jaquet, A.R.S.M &c. (4to. Sydney, 1894.)

Palæontology.
1. The Invertebrate Fauna of the Hawkesbury-Wianamatta Series of New South Wales, by Robert Etheridge, Junr., Palæontologist to the Geological Survey of New South Wales, and Australian Museum, Sydney. (4to. Sydney, 1888.)
2. Contributions to the Tertiary Flora of Australia, by Dr. Constantin, Baron von Ettingshausen, Prof. of Botany, University of Graz, Austria. (4to. Sydney, 1888.)
3. Geological and Palæontological Relations of the Coal and Plant-bearing Beds of Palæozoic and Mesozoic Age in Eastern Australia and Tasmania, by Ottokar Feistmantel, M.D. (4to. Sydney, 1890.)
4. The Fossil Fishes of the Hawkesbury Series at Gosford, by A. S. Woodward, &c. (4to. Sydney, 1890.)
5. A Monograph of the Carboniferous and Permo-Carboniferous Invertebrata of New South Wales. Part 1, Cœlenterata: Part 2, Echinodermata, &c.; by R. Etheridge, Junr. (4to. Sydney, 1891-92.)
7. The Mesozoic and Tertiary Insects of New South Wales, by R. Etheridge, Junr., &c., and A. Sidney Olliff, &c. (4to. Sydney, 1890.)
8. Contributions to a Catalogue of Works, Reports, and Papers on the Anthropology, Ethnology, and Geological History of the Australian Aborigines, Parts I and II; by R. Etheridge, Junr. (4to. Sydney, 1890-92.)

Records of the Geological Survey of New South Wales.
Vols. I—III (Sydney, 1889-93.); IV, Pts. 1 and 2. (Sydney, 1894.)

DEPARTMENT OF MINES AND AGRICULTURE, SYDNEY.

RECORDS

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RECORDS

OF THE

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Vol. IV.] 1895. [Part III.

XIX.—On a Trachytic Rock from the Coonabarabran District: by George W. Card, A.R.S.M., F.G.S., Curator and Mineralogist.

[Plate X.]

Early in the latter half of 1893 a collection of specimens from the neighbourhood of the Warrumbungle Mountains was submitted for examination by Mr. W. L. R. Gipps, of Bearbong, Gilgandra. The collection included various forms of hemi-crystalline silica, tripolite, a number of very perfect fresh crystals of felspar, and some pieces of a very compact cream-coloured rock that superficially bore some resemblance to quartzite, but were found on closer inspection to exhibit a vast number of rectangular crystal-faces, to contain small porphyritic crystals of sanidine, and to be readily scratched with a knife. A thin section was prepared, when it was at once evident that, so far as regards its constitution, the rock was typically trachyte. Various inquiries have been made with a view to obtaining information as to the mode of occurrence of the rock, and further investigation was delayed in the hope of an opportunity occurring of personally examining it in the field. It does not, however, seem advisable, considering the interest attaching to all occurrences of trachyte—one of the less common eruptive rocks—and to this in particular as being apparently the first recorded occurrence of true trachyte in New South Wales, to any longer postpone the preliminary description of the rock.

Stratigraphical Relations.—The whole of the specimens referred to are given by Mr. Gipps as coming from the cuttings of the Wantialable Creek, Parish of Urombong, County of Gowen. In the recently published Geological Map of the

Colony* this area is coloured as being occupied by the Tomago beds of the Permo-Carboniferous Formation, with a patch of Hawkesbury beds at Coonabarabran, and several areas of basic igneous rocks in the neighbourhood.

From a sketch, kindly supplied by Mr. Gipps, it would seem that the tripolite—a variety containing sponge spicules—occurs at the base of the cutting. This is overlaid by a fragmental rock which is succeeded by a bed of soft yellowish material in which the numerous felspar crystals referred to above occur; the rock now under consideration forming the surface. A few of these felspar crystals have been examined by Czabo's method by Mr. James Taylor, B.Sc., A.R.S.M., who kindly informs me that he regards them as containing a relatively high proportion of soda, and that, from this reason, as well as their somewhat low fusibility, they might perhaps be regarded as soda-orthoclase. The crystals are beautifully clear, and frequently have their crystalline form very well developed. From the information to hand it is not clear whether there is any connection between the deposit containing these crystals and the overlying trachytic rock.

General Description.—Whitish in colour with a tendency to grey or smoky. Fracture even to sub-conchoidal, breaking with sharp corners; translucent at the edges. Here and there imperfect natural divisional planes occur. With some difficulty it can be scratched with a knife, giving a white streak. Embedded in the matrix, which is compact and homogeneous, are very minute lath-shaped crystals, exhibiting glancing faces, with here and there a larger tabular crystal. In thin section, under the microscope, many of these are seen to be *Sanidine. Quartz* is very rare.

The *specific gravity*, as determined by various methods is well under 2·4, the results obtained differing somewhat. This is a low density even for a normal trachyte-glass. From the abundance of crystals contained in the glass a density somewhat above the average† might have been expected. On the other hand, it will be seen from the analysis given below that there is a total absence of heavy bases, such as iron; also, that a large amount of amorphous secondary silica is present. An analysis by the Assayer and Analyst, Mr. J. C. H. Mingaye, F.C.S., resulted as follows:—

Moisture at 100° C.	2·22
Combined water	2·17
Silica (SiO_2)	74·12
Alumina (Al_2O_3)	12·39
Ferrous oxide (FeO)	·21
Ferric oxide (Fe_2O_3)	·31
Manganous oxide (MnO)	trace.
Lime (CaO)	·30
Magnesia (MgO)	·42
Potash (K_2O)	5·07
Soda (Na_2O)	3·22
Sulphuric anhydride (SO_3)	trace.
Phosphoric anhydride (P_2O_5)	trace.
	100·33

* Geol. Survey N. S. Wales, Department of Mines and Agriculture N. S. Wales, 1893.
† 2·4.

This analysis approximates very closely to that of an average granite or felsite. To a certain extent, at any rate, the high percentage of silica is due to its presence in secondary amorphous form, of which a considerable amount can be detected under the microscope. The percentage of sòda and potash is quite normal, while the disproportion between the silica and the alumina may be partially explained by the presence of the secondary free silica. The practical absence of iron, lime, and magnesia, leaves the rock a very pure silicate of potash and soda with free amorphous silica. The chemical composition of the felspar has not been determined, but from the analysis, it would seem probable that soda-orthoclase or even oligoclase are present, as they generally are, in rocks of this class.

Microscopic Characters.—[Slide 444.]—Under the microscope in thin section the rock is seen to consist of a vast number of perfectly fresh and well-formed crystals of untwinned or simply twinned felspar embedded in a greyish matrix which is resolved by a high power into a granular colourless glass containing very many microlites of felspar. Two distinct sets of felspar crystals are present. The one consists of a multitude of lath-shaped individuals, sometimes seen in cross-section, averaging perhaps ·15 mm. in length; these are generally simply twinned, and are arranged in groups each having a general trend in an approximately fixed direction. Occasionally a bent or broken individual is seen. Sometimes (*see* Pl. X) they flow round the porphyritic constituents, and were evidently in existence while the rock was still in a viscous condition. The other set includes porphyritic more or less tabular individuals and aggregates of very clear and frequently idiomorphic felspar. These are all untwinned, but the polarisation effects are very irregular, indicating conditions of molecular strain. They have been somewhat corroded by the magma, the corrosion sometimes (*see* plate) acting most energetically along certain crystallographic planes, giving rise to a somewhat stepped structure. A good deal of glass is included in one of the aggregates. In many of the medium-sized individuals, more especially, the crystal-edges are completely obliterated by interaction between the felspar-substance and that of the matrix; the zone of interaction sometimes exhibiting a reddish tinge.

A considerable quantity of a clear, slightly polarising substance, with irregular outlines and a concentric arrangement, is present. There can be little doubt that this is silica, and the high percentage of that element given by analysis can be explained by its presence, as can also, perhaps, the compact texture and rather low specific gravity of the rock.

The only other constituent is represented by a few specks of a green and brown pleochroic mineral.

XX.—Notes on the Occurrence of Monotreme Remains in the Pliocene of New South Wales: by W. S. Dun, Assistant Palæontologist and Librarian.

[Plates XI and XII.]

I.—Introduction.

The living representatives of the Monotremata are, perhaps, the most interesting forms of the peculiarly characteristic elements of the Australian mammalian fauna, embodying as they do both reptilian and marsupial characters. On this account the occurrence of remains representing new species of a gigantic *Echidna*, and also of an *Ornithorhynchus* in the Pliocene of the Canadian Lead, Gulgong, will form very welcome additions to our Tertiary Mammalian Fauna. The discovery of our specimens was announced by the late Mr. C. S. Wilkinson in 1886* as having been found by Mr. William Thew in the gold-bearing wash in a limestone cavern, at a depth of one hundred and thirty feet. He states that Dr. E. P. Ramsay identified, in the same collection, remains of *Megalania*, kangaroo, and birds. As far as previous records of fossil Monotremes in Australia are concerned, the late Mr. Gerard Krefft, in a letter† to the "Annals and Magazine of Natural History" in 1868, drew attention to remains of the articular head of a humerus of an extinct *Echidna* from the Pleistocene deposits of Queensland. To this form he gave the tentative name of *Echidna Oweni*. His letter was accompanied by drawings. In 1884 the late Sir Richard Owen described‡ the left humerus of an *Echidna* from the Wellington Caves Bone-deposits. This form Sir Richard described as *E. Ramsayi*. Mr. R. Lydekker has pointed out in the B.M. Catalogue of Fossil Mammals§ that as the specimens seem to agree very closely, Krefft's species, *Echidna Oweni*, made in 1868, will have to be given priority, so that the form will be known as *E. Oweni*, Krefft. Mr. Lydekker also includes, for Palæontological purposes, the New Guinea genus *Proechidna* with *Echidna*. Whilst giving these few notes on the history of the fossils specimens of *Echidna*, attention should be drawn to a remark made by the late Mr. Gerard Krefft in his "Report on the Exploration of the Wellington Caves" with the late Professor A. M. Thompson of the Sydney University.|| This report was made to the Colonial Secretary (the late Sir John Robertson), in 1870, but was not published till 1882. He says:—"Order Monotremata. Of the two singular genera belonging to this strictly Australian order, very few remains have been discovered, and none as yet of the *Ornithorhynchus*. The Echidna or ant-eater has been observed before, and is

* Ann. Rept. Dept. Mines N. S. Wales for 1886 [1887], p. 138.
† Ann. & Mag. Nat. Hist., 1868, I (4), pp. 113–114.
‡ Phil. Trans. R. Soc., 1884, Pt. I, pp. 273–275, pl. 14.
§ Vol. V, pp. 295–296.
|| Exploration of the Caves and Rivers of New South Wales (Minutes, Reports, Correspondence, Accounts). *N.S. Wales Parl. Papers*, 1882, 162—A, pp. 52, plates, &c. (Folio, Sydney. By Authority), p. 11.

represented by a fossil arm-bone from Queensland. [Evidently refering to the bone mentioned in the Ann. and Mag. Nat. Hist.] The caves of Wellington yielded a fractured femur of a species larger than our present *Echidna hystrix.*"

In 1885 Mr. C. W. de Vis, M.A., Curator of the Queensland Museum, announced the first discovery of remains of *Ornithorhynchus* in Australian Post-Tertiary deposits, and described* the right tibia and mandible of an *Ornithorhynchus* from Post-Tertiary deposits at King's Creek, near Pilton, Q.—this he named *O. agilis.* This species, as pointed out by Mr. de Vis, is very remarkable from its small size, and as a contrast to this, it is extremely interesting to find so large a species as *O. maximus* occurring in the Pliocene at the Canadian Lead. In the same paper he mentions a claw-bone at present in the Brisbane Museum as probably referable to *E. Oweni*; Krefft. From these few remarks it will be seen that extinct Monotreme remains are very scarce, those at present known to me as occurring in Australian collections being:—

Ornithorhynchus agilis, *de Vis.*

1. Right tibia and mandible. King's Creek, near Pilton, Q.; Post-Tertiary. Type in the Queensland Museum, Brisbane.

Ornithorhynchus maximus, *Dun.*

2. Right humerus. Canadian Lead, Gulgong; Pliocene. Type in the Mining and Geological Museum, Sydney.

Echidna (Proechidna) Oweni, *Krefft.*

3. Clawbone. Queensland; Post-Tertiary. In the Queensland Museum, Brisbane.

4. Articular head of humerus. Darling Downs, Q.; Post-Tertiary. Type in the Australian Museum, Sydney. This is the specimen figured by Krefft in the "Annals and Magazine of Natural History."

5. Left humerus. Wellington Caves; Post-Tertiary. Type in the Australian Museum, Sydney. This is the specimen figured by the late Sir Richard Owen in the Phil. Trans., 1884, as *E. Ramsayi.*

6. Scapula and portion of interclavicle or episternum. Wellington Caves; Post-Tertiary. Australian Museum, Sydney.

7. Portion of a femur. Wellington Caves; Post-Tertiary. Australian Museum, Sydney.

8. Clawbone. Wellington Caves; Post-Tertiary. Mining and Geological Museum, Sydney.

Echidna (Proechidna) robusta, *Dun.*

9. Portion of skull and atlas vertebra. Canadian Lead, Gulgong; Pliocene. Type in the Mining and Geological Museum, Sydney.

* Procs. R. Soc. Queensland, 1885, II, pp. 35-38, pl. 6.

II.—Geology.

The Geology of the Gulgong District, and the relations of the Deep Leads, have been described by the late Mr. C. S. Wilkinson *. The town of Gulgong is situated on a range "composed of granites and Upper Silurian conglomerates, schists and limestones, intruded by large masses and dykes of greenstone diorite." It is on the flanks, and at the bases of this range that the leads occur. These leads have yielded almost the whole of the gold obtained in the district. The chief leads here are Adams' Lead, Black Lead, Moonlight Lead, and the Happy Valley Lead. The Canadian Diggings are situated four and a half miles south-east of Gulgong, and here several leads are united to form the Canadian Lead, which runs to Home Rule. There is a considerable tract of basalt around Gulgong, which in many places covered over the wash in the old drainage channels. In another report Mr. Wilkinson gives a much more detailed account of the Canadian Lead, and I may, perhaps, be excused for quoting it in its entirety, as it is practically the only account we have. He says, " A very remarkable feature in connection with the deep lead is the deposit of auriferous wash in limestone caverns at the Canadian. Here some massive beds of marble limestone occur, and in the tertiary pliocene period contained caves into which the ancient river drained, just as the streams do at the present day at the Jenolan Caves and elsewhere. At length these old caves became filled up with the gold-bearing gravel and silt, and the valley also, to a level of about eighty feet above that of the caves. At the White Horse claim, which is under the able management of Mr. Thompson, a shaft has been sunk below the level of the old river-bed or lead, and into the cave deposit, to a depth of two hundred feet and thirty six from the surface, without reaching the bottom of the cave. In one part the cave is oblong, measuring one hundred and ten feet by forty-three feet, and funnel-shaped, diminishing in size downwards, with uneven walls, and smaller caves leading into it. It is filled with a stiff ferruginous clay, called by the miners 'pug,' and occasional floors or layers of wash, with limestone boulders, and a little quartz. * * * A similar cavern deposit has been worked in the Canadian prospecting claim, which is situated about half a mile S.S.E. from the White Horse claim." In another place, speaking about the flow of the basalt in the old drainage channel, Mr. Wilkinson says, † " I say some of them ; for whereas a large stream descended from the mountains on the east, flowing in the Cooyal Creek Valley, near Gulgong, thence into the Cudgegong Valley, covering up the river channels of the pliocene period, the upper part of the Cooyal Valley, where the Home Rule and Canadian leads occur, escaped this flood of molten lava." Professor David likewise considers that these lavas are of Pliocene age, and that they are probably homotaxial with the Pliocene lavas of Victoria. ‡

* Ann. Rept. Dept. Mines N. S. Wales for 1876 [1877], pp. 166-174 ; *Ibid.* for 1886 [1887], pp. 134-139.

† *Ibid*, p. 130.

‡ Proc. Austr. Assoc. Adv. Sci., 1894, V., p. 402. See also Clarke, Sed. Form. N. S. Wales, 4th Ed., 1878, pp. 89, 93, 106, for remarks on the Geology of this District.

Remains of a fairly abundant flora have already been collected from these Gulgong Deep Leads, and have been described by Baron F. v. Mueller.* They comprise the following genera and species:—

Phymatocaryon bivalve, *F. v. M.*
" McKayi, *F. v. M.*
" " *var* quinquevalvis, *F. v. M.*
" angulare, *F. v. M.*
" " *var.* elongata, *F. v. M.*
Wilkinsonia bilaminata, *F. v. M.*
Illicites astrocarpa, *F. v. M.*
Pentacoila gulgongensis, *F. v. M.*
Pleiacron elachocarpum, *F. v. M.*
Ochthodocaryon Wilkinsonii, *F. v. M.*
Plesiocapparis leptocelyphus, *F. v. M.*
Acrocoila anodonta, *F. v. M.*
Spondylostrobus Smythii, var. cryptaxis, *F. v. M.*
Eisothecaryon semiseptatum, *F. v. M.*

Mr. R. Etheridge, Junr., has recorded the occurrence of a *Unio*, *U. aucklandicus*, var. *Wilkinsoni*, Eth. fil., in the lead at Home Rule.† Among the Vertebrates remains of *Meiolania platyceps*, Owen, and a turtle allied to *Chelodina sulcifera*, Gray, have been recorded by the same Author.‡ From the Magpie Lead, Mr. Wilkinson§ reported finding remains of *Diprotodon*, *Halmaturus* and *Macropus*, while he records as before mentioned from the Canadian Lead remains of *Meiolania* [*Megalania*], *Macropus*, *Echidna*, and birds. To this fauna of the leads may now be added *Echidna (Proechidna) robusta*, Dun, and *Ornithorhynchus maximus*, Dun.

III.—Description.

Echidna (Proechidna) robusta, *sp. nov.*

Skull.—The portion of the skull that is preserved consists of the upper part of the cranium, the remains of the occipitals and about half of the rostrum, of which unfortunately not enough remains to show the premaxillaries. In common with recent adult Monotreme skulls this specimen shows very little, and in most instances, no traces of sutural connection between the bones of the skull. Taking into consideration, first, the general contour of the skull, it will be seen, apart from the great difference in size, that the frontal curve more nearly approaches that of *Proechidna* than *Echidna*. In *Echidna hystrix*, var. *aculeata* the angle is fairly steep, curving off gradually into the prolongation of the rostrum, which in

* Ann. Rept. Dept. Mines N. S. Wales for 1876, [1877], pp. 178-180; *Ibid* for 1878 [1879], pp. 169-172, pls. 3 and 4.
† *Ibid* for 1878 [1879], pp. 164-169, pl. 3, fig. 5.
‡ Records Geol. Survey N. S. Wales, 1889, I, Pt. 3, pp. 149-152, pls. 25, 26.
§ Ann. Rept. Dept. Mines N. S. Wales for 1876 [1877], p. 172.

its entirety is curved slightly upwards; in *Proechidna* the angle is not only less steep, but the curve is less marked, and in some cases almost absent, while the rostrum is curved downwards to a very well marked and constant degree. In *E. robusta* the frontal angle is about the same as in *Proechidna*, curving very gently to the rostrum, which, if perfect, would probably show a slight downward curve. The breadth of the palate at the foot of the zygomatic arches is twenty-two mm. as compared with a similar measurement of sixteen mm. given by a skull of *Proechidna Bruijnii.* The palate is much more concave than in *Proechidna*, and the thickness of the rostrum at the same place is in the ratio of sixteen mm.; thirteen mm. From a comparison of these measurements with those of a cast of a skull of *Proechidna* in the Departmental Collection, an approximate basal length, that is, a length from the foramen magnum to the gnathion or anterior point of the premaxilla, of two hundred and sixty-five mm. is obtained for our specimen. Such a measurement is decidedly only approximate, and no doubt would be much more valuable were there more skulls of *Proechidna* available for comparison; but it may be of some use as giving a rough idea of the length of skull of this ancient *Echidna.* Mr. Oldfield Thomas in his Catalogue of Marsupials and Monotremes* gives the basal length of the skull of an adult male *Proechidna Bruijnii* as one hundred and fifty-six mm., whereas the measurements of an adult female specimen are given by him as one hundred and eighty-two mm. According to this, if any value at all can be placed on the comparison, the skull of *Echidna robusta* may be assumed to be half as long again as that of *Proechidna Bruijnii.* As in *Proechidna* the lateral borders of the palate are much elevated giving a great concavity to the rostrum. From what remains of the inner part of the cranium it may be seen that the surface of the brain is more convoluted than is the case in *Echidna*, agreeing in this respect with *Proechidna* as pointed out by Gervais in his "Osteographie des Monotremes," in which he remarks "La boîte cérébrale est en même temps plus ample [than in *Echidna*] et le moule de sa cavité interieure montre qu'il existe une plus grande complication des circonvolutions propres aux hemispheres cerebraux."† The broken portion of the rostrum shows the nasal passages with a thick nasal septum.

Pl. XII, Figs. 3 and 5 show what remains of the occipital region of *P. robusta.* They show portion of the basi-occipital and the occipitals, with their well-marked condyles for articulation with the atlas vertebra. In Pl. XII, Fig. 4 is seen the upper triangular portion of the very large foramen magnum bordered by the exoccipitals. The right-hand portion of the supra-occipital is present in part, but in common with the other bones of the cranium owing to the indistinctness of sutural junctions nothing can be made out of its outlines. Portion of the parietal, and the frontal and nasals in part, are preserved. Part of the right alisphenoid and of the orbito-sphenoid are also to be seen. The anterior portion of

* Brit. Mus. Cat. Marsupials and Monotremes, 1888, p. 384.
† Ostéographie des Monotremes vivants et fossiles, p. 40.

the styliform zygomatic arch is preserved, with the malar articulating with the maxillary. On the inner side of this arch is a very well marked foramen running forwards; and in front of it is a well marked groove running forwards and upwards. All these portions, as far as can be made out from the little that remains, are very similar to similar regions in *Proechidna.*

The atlas vertebra (Pl. XI, Figs. 4 and 5) is almost perfectly preserved, the portions wanting being the neural spine and the transverse processes. On the anterior aspect will be seen the well marked anterior zygapophyses for articulation with the occipital condyles. These are large, well hollowed, ear-shaped, and more nearly approaching in general form the corresponding parts of *Proechidna Bruijnii* than its much smaller ally *Echidna aculeata.* The posterior zygapophyses are narrower, less hollowed than the anterior, the curve of the inner margin is more regular, there being no lower lobe—as is the case in the anterior zygapophysis—the articular surface merging gradually into the inferior arch. The transverse processes have been broken off near their bases, but allowing for the difference in size, the basal portions do not show any difference, beyond perhaps a slightly more marked hollowing at the upper border, from those of *E. aculeata.* The neural arch is much thicker and more developed than in either *Echidna* or *Proechidna*; it is divided into two well-marked surfaces, that directed forwards and bearing the neural spine or tubercle, and that sloping posteriorly. This neural spine sems to be very differently constituted than is the case in *Proechidna Bruijnii* or *Echidna aculeata.* Unfortunately I have not been able to obtain specimens of this bone of *Proechidna* for examination, but judging by the figure given by Gervais* there would seem to be only a small tubercle developed, less marked than is the case in *Echidna aculeata.* This anterior slope has a width of 10·5 mm., and the neural tubercle, of which unfortunately only the base remains, has its origin along the entire width of the slope and a thickness at the base of five mm. In *Echidna aculeata,* var. *hystrix,* the corresponding tubercle seems to be developed in a somewhat different manner, and instead of being laterally flattened its width is much greater than its thickness and is practically in the same plane as the posterior slope of the neural arch.

These vertebral and cranial remains seem to show a greater resemblance to *Proechidna* than *Echidna,* though it must not be overlooked, as has already been pointed out by Mr. O. Thomas† that it is by no means certain that these two are generically separate. On account of its size it is proposed to record it as *Echidna* (*Proechidna*) *robusta.*

IV.—Ornithorhynchus maximus, *sp. nov.*

The right humerus (Pl. XI, Figs. 1–4) that is taken to represent this species, is undoubtedly referable to a gigantic species of *Ornithorhynchus,* which it is proposed to name *O. maximus,* on account of its great size. The most striking

* Ostéographie des Monotremes vivants et fossiles. Atlas, Pl. 8, figs. 1. and 1a.
† *Loc. cit.* p. 383.

point in it is its great size, there being but few differences apart from that between it and the corresponding bone in the recent *O. anatinus*. The length from the uppermost surface of the ectotuberosity (great) to the process is eighty-four millimetres; the breadth across the head, between the ento-(lesser) and the ecto-(greater) tuberosities is forty-four millimetres; the width of the shaft just above where the distal expansion begins is twenty-five millimetres, and the width between the entepicondyle (internal) and the ectepicondyle (external) is seventy-two millimetres. The humerus may be considered to be made up of three well-marked surfaces; (1) of the antero-internal, which at the proximal end bears the articular head, and the bicipital groove, is bordered laterally by the internal and anterior borders, and distally is continued to the internal condyle; (2) the antero-external, which on the front view consists of the slope that is continued into the external condyle and is laterally continued up to the deltoid ridge; and (3) the posterior surface. Taking first into consideration the articular head, this seems to be more sharply marked off from the body than in the recent species, and as will be seen in Pl. XI, Fig. 3, the general outline of the surface is very similar The bicipital groove is very well-marked, but the border of the great tuberosity does not overhang it to the same extent as in *O. anatinus*. Going further down the shaft the surface is seen to be practically smooth, showing below the distal border of the bicipital groove a well-marked scar of attachment for the coraco-brachialis brevis muscle, but no sharply-marked hollow as in the recent form; moreover the surface is fairly in one plane, and not curved strongly forward as in *O. anatinus*. The distal border of the internal condyle is bordered by well-marked ridges running from the process for the attachment of the pronator teres muscle. The supracondylar foramen is large and well-marked, situated relatively closer to the distal extremity than in the recent species. In *Echidna hystrix* this foramen is relatively much smaller than in *Ornithorhynchus*; and it may be mentioned incidentally that the form of this bone varies very much in these two genera. Speaking generally, the surfaces of the humerus are much smoother in *Echidna* than in *Ornithorhynchus*, and the surface is not so ridged, the supracondylar foramen is much smaller, the external condyle is not so prolonged, there is no well-marked sesamoid bone at the back of the deltoid ridge, while the supinator ridge, that in *Echidna hystrix* runs upwards from the external condyle and separates the posterior and antero-external faces, runs out at about the distal two-thirds, is in *Ornithorhynchus* continued almost up to the head.

Returning now to the fossil form it will be seen that the general form of the trochlea (Pl. XI, Fig. 4) agrees well with that of the recent species. The external condyle is unfortunately slightly damaged so that that is impossible to say with certainty that there was a beak extending out from it to the same marked extent as in *O. anatinus*. The antero-external face is not so deeply

grooved behind the deltoid ridge, which bears a well marked sesamoid, as in the recent species, and the ridge running in the recent species diagonally across the upper portion of this surface, starting from a point just below this sesamoid, and forming one of the boundaries of this groove is not to be clearly seen in *O. maximus*. The area covered in the recent species by the attachment of one of the internal humeral heads of the triceps muscle is represented in our specimen by a fairly well marked attachment scar covering the greater part of this surface. Coming now to the posterior surface we notice first the very well marked supinator ridge running up from the external condyle towards the proximal extremity, this is continued almost to the proximal end in marked contrast to the condition that, as already pointed out, prevails in *Echidna*. This surface is generally flatter than in the recent species. The attachments of the humeral portions of the great triceps muscle are well seen. At the junction of the proximal one-third with the distal two-thirds is a well-marked tuberosity, whose face is convex and smooth, and resembles in position and general character the similar tuberosity in *O. anatinus* which has a well-marked sesamoid bone attached, and which gives attachment to the subscapularis muscle. The structure of this portion is very different from that of *Echidna*.

V.—Conclusion.

The affinities of the Monotreme humerus with that of *Platypodosaurus* and other Anomodont Reptiles from the Trias has already been pointed out by the late Sir Richard Owen in several papers.* He lays especial stress on the great development of the tricipital process in *Platypodosaurus* and remarks on the presence of a similar process in *Echidna*, *Ornithorhynchus*, and in some Marsupials to a less degree. On reference to Pl. XI, Fig. 1, it will be seen that we have a very well marked process before us, though of course not so marked as in the Triassic Reptile figured by Owen. The resemblances between the humeri of Monotremes, Birds and Reptiles, has also been dealt with, among many others, by Dr. Ch. Martins, who in a paper† published in 1874, gives a discussion of the views on this relationship put forward by Home, de Blainville, Meckel, Saint-Hilaire, Cuvier, and Owen, and deals to some length with the degree of twisting of this bone which he considers in Monotremes to amount to 90°.

The discovery of these remains may be summed up as giving the following information:—

1. That they most probably represent the oldest recorded Australian Monotremes, and come from a deposit that is generally admitted to be of Pliocene age.
2. *Echidna robusta* appears to be more nearly related to *Proechidna* than to *Echidna*.

* Quart Journ.. Geol. Soc., 1880, XXXVI, pp. 418-420; Phil. Trans., 1884, p. 275. See also Lydekker in Nicholson and Lydekker's Manual of Palæontology, 1889, Vol. II, pp. 1054-1055; Cope, Procs. Am. Assoc. Adv. Sci., 1884 [1885], XXXIII, pp. 471-482.

† Ann. Sci. Nat., Zool., & Pal. 1874, XXIX (5), pp. 1-9.

3. That it was much larger and more robust than the living forms and also than *E. Oweni.*
4. Apart from its size and power, it does not appear to be much differentiated from the living forms.
5. In *Ornithorhynchus maximus* we have a gigantic ancestor for our living Platypus, which in the structure of its humerus seems to differ but little except in the point of size.

In conclusion, I have to acknowlege my indebtedness to Dr. W. J. Stewart McKay, M.B., Ch.M., B.Sc., for the great assistance he has rendered me in advice and in putting at my disposal the results of his recent work on *Echidna* and *Ornithorhynchus.**

XXI.—Notes on the Geology of the Auriferous Gravels occurring in the upper portion of the Shoalhaven Valley, N. S. Wales: By J. B. JAQUET, A.R.S.M., F.G.S., Geological Surveyor.

[Plate XIII.]

THE Shoalhaven River has its source in Jinden Mountains fifty miles south of Braidwood, and flows into the Pacific Ocean at Nowra, distant eighty miles in a southerly direction from Sydney.

Throughout the valley, at various altitudes above the present river bed, which seldom, if ever, exceed one hundred and fifty feet, deposits of gravel and other drift material occur; deposits which are composed of the detritus carried down by the stream in past ages when it flowed through channels other than the one it pursues to-day.

All these sediments, which in the aggregate cover many square miles of country and frequently possess a thickness exceeding one hundred feet, contain more or less gold. In a few places the precious metal occurs in sufficient quantity to enable the miner to make a profit by winning the wash-dirt by a system of drifting; in other places mining can only be profitably undertaken when, a convenient supply of water being available, the ground can be sluiced; in yet other places the gravels yield but a trace of gold, and from a miner's point of view are utterly useless. So much of the ground, more particularly where it attains a great depth, is unprospected that one would not, I think, be justified in speaking definitely as to what fraction of the whole drifts each class enumerated above respectively occupies. It is certain, however, that very little gold could be profitably won

* Procs. Linn. Soc. N.S. Wales, 1894, IX (2), Pt. 2 pp. 263–360, pls. 20–23.

except by a system of sluicing, and having regard to the results hitherto obtained, one would expect to find the gravel more often not rich enough for sluicing than contrariwise. On the other hand, there is but little doubt that had not obtaining the requisite water been a difficult and costly operation, placer mining on a very large scale would long ago have been in operation in many places along the valley.

In the past sluicing has been carried on in a more or less desultory manner, and with partial success. Sometimes a few sluice-heads of water have been rendered available by cutting a race and diverting the waters of an affluent stream, or more rarely those of the river itself; again, elsewhere, water at a pressure has been obtained by means of pumps. At " Croaker's Mint," near Oallen, considerable success has attended the introduction of this latter method; for a run of thirty days ninety-one ounces of gold were recently obtained, this result yielding a handsome profit to the shareholders.

I have only had an opportunity of making a detailed examination of the river and its associated formations, in the vicinity of Braidwood—between Jembaicumbene Creek, in the Parish of Boyle, and Reedy Creek, in the Parish of Larbert, and the remarks which follow have more particularly reference to this area; I have, however, made a cursory examination of the geological features both above and below these points, and may in places refer incidentally to them.

The formations represented are as follows:—

Sedimentary	Silurian—slates and limestones.	
	Devonian (Upper)—sandstones, conglomerates, and shales.	
	Pleistocene and Recent—auriferous gravels, sands, and clays.	
Intrusive and Volcanic	Acid	Hornblende-granite.
		Quartz-felsite.
	Basic	Basalt.

The Silurian rocks are much contorted, and for the most part possess a meridional strike, and dip at a high angle.

The Devonian rocks are either horizontally bedded or but slightly tilted. They occur as outliers, resting unconformably upon the Silurian slates; also are they found in places both upon the quartz-felsite and granite. These beds have yielded, in the neighbourhood of Major's Creek township, specimens of *Lepidodendron australe*, M'Coy, and marine fossils.*

The granite is composed of quartz, triclinic-felspar, dark mica, and hornblende; it is often much impregnated with pyrites. When examined in thin sections under the microscope, the felspar grains are frequently seen to exhibit zonal structure; in one grain examined by the Writer, no less than four periods of growth can be

* Records Geol. Survey N. S. Wales, 1893, III, Pt. 4, p. 199.

distinguished. My late colleague, Mr. W. Anderson, who spent some time examining these rocks, was of opinion that the granite had a later origin than the quartz-felsite.*

The quartz-felsite is composed of much corroded quartz idiomorphs, imbedded in a quartzo-felsitic base, and has either a dark-grey or flesh-pink colour. In places it passes by insensible gradations into a fine-grained felsite. It intrudes the Silurian rocks. I have previously stated that outliers of the Devonian sandstones and conglomerates rest unconformably upon the Silurian slates; and Mr. Anderson has pointed out † that, since in places the basal beds of the Devonian series are in part composed of quartz-felsite pebbles, the sedimentary rocks had a later origin than the intrusive; hence we may be warranted in assuming that the intrusion of the quartz-felsite occurred between the Silurian and Upper-Devonian Epochs.

Dykes of basalt occur at Bell's Creek and elsewhere, while in the Jerrabat Gully, about twelve miles north of Major's Creek township, the older rocks are covered over a small area by a sheet of this rock.

The drifts consist of alternating beds of gravel, sand, and clay. The component pebbles of the gravel, and the grains forming the sand, are for the most part loosely cemented together, though sometimes the latter is of a "running" character. The clay for the most part consists of kaolin, produced probably on the decomposition of the felspars in the granite, it often has a number of angular or subangular quartz grains associated with it. Thin beds of a stiff dark-blue clay occur in those places where the sediments attain a great thickness.

The only organic remains which have hitherto been discovered consist of fragments of silicified wood.

The pebbles which go to form the gravels are for the most part composed of a sandstone which, being lithologically identical with the Devonian sandstone found *in situ*, has evidently been derived therefrom. The fact that boulders of quartz-felsite and granite are, relatively speaking, scarce is probably due to the fact that during the Pleistocene Period, when the greater portion of the drifts were formed, the Devonian outliers covered a much larger area of country; and also to the fact that these rocks more readily underwent disintegration than the sandstone.

The gold occurs as extremely small flaky particles, which are for the most part congregated near the bottom of the beds, though in nearly all cases a little of the metal will be found throughout the gravel. Occasionally it happens that a bed will have gold uniformly distributed through it, and instances are to be found where the upper or central portions of a bed are the richest. Generally speaking, a much larger quantity of gold is contained in the bed of gravel resting immediately on the bedrock than in any other one occurring higher up in the series; yet in a number of instances, a good yield is obtained on a "false-bottom," and

* Ann. Rept. Dept. Mines and Agric. N. S. Wales for 1892 [1893], p. 121.

sometimes an even better one than from the true bottom below. For further information concerning the amount of gold contained in the drifts and the distribution of the same, I may refer the reader to my Reports in connection with the proposed Government Race.*

Accompanying this paper will be found a plan of the drifts (Pl. XIII) occurring upon the Shoalhaven River in the Parishes of Warri and Jinglemoney, together with a section across the same, as proved by shafts put down under the supervision of the Writer.

In the absence of fossils other than silicified wood we are unable to assign any exact age to the sediments; however, they have probably all been formed during Post-Tertiary times, and they are still accumulating at the present day. That a long period of time has elapsed since the oldest drifts were laid down, is evidenced by the height at which they occur above the present river and by their great thickness.

No sharp line of demarcation can in most instances be found between the older and younger deposits; the one more often passes by insensible gradations into the other. Yet, on the other hand, can a variance be observed between drifts of widely different age: *cæteris paribus*, the younger the sediment the richer it is in gold, and the larger the boulders which it includes. The more recent deposits have without doubt been in part formed from the material set free on the disintegration of the older ones; the former in fact bear the same relation to the latter as the concentrates in the sluice-box do to the ground in the face of a claim, and in this manner the larger quantity of precious metal which they contain may be accounted for.

The question will be asked: Where has all this alluvial gold come from? My investigations do not enable me to give any satisfactory answer. It is true that auriferous reefs occur in the granite near Major's Creek and in the quartz-felsite at Jerrabat Gully; but the occurrence of the precious metal *in situ* at these two places would not seem to justify the conclusion that the whole of the gold found in the upper portions of the river had been derived from reefs situated in the intrusives.

Mr. W. Anderson suggested when discussing the probable origin of the gold occurring in the drifts which accompany the Jembaicumbene Creek, a tributary of the Shoalhaven, and other auriferous deposits in the vicinity, that the precious metal had been derived from the denuded portions of the Palæozoic rocks. In connection with this theory, I would point out that in none of the outliers which have escaped denudation have any gold reefs hitherto been found. Reefs in many places occur, and are being worked, in the Silurian slates, but not in the Devonian sandstones and shales of which the outliers are composed.

It is a noticeable fact that coarse gold is only found in the river drifts below the point where Silurian slates become the dominant country rock.

* *Vide* Ann. Rept. Dept. Mines and Agric. N.S. Wales for 1894 (*in litt.*)

XXII.—Mineralogical Notes, No. 3: by GEORGE W. CARD, A.R.S.M., F.G.S., Curator and Mineralogist.

I.—Contents.

II.—Mineralogical Notes.

1. *Andalusite from Tumbarumba.*—Rolled pieces from Burra Creek. Specimens have been received from Mr. S. F. Ramsay, of Tumbarumba, and from Mr. J. E. Carne, Geological Surveyor. Masses up to a pound in weight occurred among these The mineral varies from colourless to brown-red and even blue, the different tints sometimes occurring in one and the same specimen. No definite crystalline form is noticeable, the masses having a coarsely radial structure.

A partial analysis, made under the direction of the Assayer and Analyst, Mr. J. C. H. Mingaye, F.C.S., gave the following results*—

Silica ($Si\,O_2$) about 35 per cent.
Alumina ($Al_2\,O_3$) about 60 per cent. with some ferric oxide.
Magnesia (MgO) about 3 per cent.

A very little water and sulphuric anhydride were also present.

The percentage of magnesia present would thus appear to be exceptionally high, andalusite and the allied silicates of alumina not generally containing even one per cent.

Andalusite is said to occur near Bungonia.† Pseudomorphs of a mineral resembling hydro-mica, apparently after andalusite have been found near Cobargo.

2. *Platinum from Fifield.*—Small quantities of platinum have long been known to occur in the auriferous wash of Fifield (Burra Burra, Forbes District). It is now being found in coarse grains, the standard of purity being fairly high.

* 94/539.
† A. Liversidge, Minerals of New South Wales (8vo. London, 1888).

An analysis* by the Analyst and Assayer giving the following results:—

Platinum	75·90
Iridium	1·30
Rhodium	1·30
Palladium	traces.
Osmiridium	9·30
Iron	10·15
Copper	·41
Gold	nil.
Lead	traces.
Insoluble	1·12
	99·48

Three specimens of the drift have been received in which both gold and platinum in a rolled condition are embedded. It is, of course, only by a very loose mode of expression that the metals can be described as "occurring in the matrix," their mode of occurrence being truly alluvial. It is reported that nuggets weighing several grains have been found. Two, very well rounded, are now in the Mining and Geological Museum, weighing 28·7425 grs. and 30·772 grs. respectively.

3. *Gold on Gypsum from West Australia.*—From Lake Austin, Murchison Gold-field. Coarse gold in a small piece of feruginous non-crystalline gypsum. It is said to be associated with pure fibrous gypsum.

4. *Gold on Bornite from Woodstock.*—Free gold on the copper ore of the Burley Jackey Mine. The gold is very pale in colour.

5. *Iodide of Silver from Broken Hill.*—Several fine specimens on kaolin, in the form of plates about one-sixteenth of an inch in thickness. Another specimen shows the iodide in large but indeterminate crystals, on ferruginous oxide of manganese. One or two small crystals of embolite are seated on the iodargyrite. Believed to have come from the Proprietary Mine.

6. *Marshite*† *from Broken Hill.*—Three very good specimens of this mineral have been recently received. In one of these, sent by Mr. Uhren, of the Proprietary Mine, the marshite occurs in the cavities of a small piece of sooty-black cerussite. One of the edges has a length of three millimetres. Triangular forms—nearly, if not quite equilateral—are very evident. The other two specimens are believed to have come from the same mine. In these cuprite and cerussite, coated with malachite, constitute the main mass, the marshite crystals occupying the cavities. Triangular faces are again very prominent. Many of the faces have a highly-vitreous lustre; others are deeply striated, giving rise occasionally to step-like triangular elevations or depressions.

* 94/506.

† Marshite is an iodide of copper. Its general characters have been described by its discoverer, Mr. C. W. Marsh, in a paper communicated to the Royal Society of New South Wales, by Prof. Liversidge, M.A., F.R.S. (*Journ. R. Soc. N. S. Wales*, 1892). The reactions for copper and iodine can be readily obtained from the smallest fragment. It seems likely that the mineral is not of uncommon occurrence.

In all these specimens the colour of the marshite is a rather light shade of brown, with a more or less pronounced tinge of red.

Some at least of the crystals should lend themselves well to accurate goniometric measurement *in situ*, and it is to be hoped that a detailed crystallographic description of this newly-discovered mineral may soon be forthcoming.

7. *Supposed Lavendulan from Carcoar.*—Some specimens of erythrine from the cobalt mines, brought by Mr. T. W. Atherton in 1893, show a thin encrustation of a lavender-blue substance in part intimately associated with the erythrine. The encrustation is too thin to admit of much being done in the way of testing, but reactions for arsenic and cobalt can be obtained.

8. *Gem-sand from the Oberon District.*—On several occasions recently samples of gem-sand purporting to come from remote gullies to the "west of Mount Victoria" have been submitted for report.

In the first instance, a small *diamond* — a crystal having the form of the hexakis-tetrahedron—was brought in. This specimen is now, I believe, in the possession of a resident of Mount Victoria, who is quite satisfied of its having been found where stated. At subsequent dates four other samples have been received, an examination of which has afforded the following results :—

1. A quantity of blue and green *corundum* (*sapphire*), and of brown and colourless rolled *zircon*.
2. A sample consisting of *quartz*, a very little *topaz*, and red-brown and colourless *zircon*. The coloured zircons occur in beautiful little crystals up to two mm. in length, and of a simple crystallographic form—a prism terminated by a pyramid.
3. Similar to the last, only the zircons were all coloured, and the crystals very perfect.
4. *Quartz* and red-brown *zircon*; the latter in moderately perfect crystals, one with little or no prism. With these stones was submitted a number of pieces of dark-coloured "cement," in one of which could be seen a cavity from which a zircon with pyramidal terminations had been taken. A quantity of the loose stuff was treated with hydrochloric acid, and then washed. It was found to be very ferruginous, and yielded sub-angular *quartz* and some *zircons*, the latter resembling in every respect the stones brought from the district. The "cement" was said to crop out a few feet above the bed of the creek.

Inquiries have shown that the locality where this gem-bearing material occurs is the Duckmaloi Creek, sixteen miles from Hampton, and six from Oberon. It is also stated that a diamond was found there many years ago. The appearance of the zircon cystals is so very characteristic that they can be readily recognised by it as coming from this locality. Their unrolled condition indicates the near proximity of the source from which they have been derived; and there

are, indeed, in the neighbourhood masses of syenitic and other rocks which may well have been their original home. Of course, it by no means follows that the diamonds have been derived from the same source as the zircons.

The zircons are of no value economically, and diamonds have been found at different times in various parts of the Oberon District.

9. *Pickeringite from Mount Victoria.*—Collected by Mr. H. G. Rienits, from crevices in a conglomerate underlying the Coal-measures near the extreme point of the mount. A specimen in the Mining and Geological Museum shows the mineral occupying a crevice about two and a half centimetres wide, which it nearly fills with silky acicular crystals growing transversely in the usual way. A portion of this specimen analysed by the Assayer and Analyst had the following composition:—*

		The soluble portion calculated to one hundred.
Water	37·23	45·08
Alumina (Al_2O_3)	10·65	12·90
Ferric oxide (Fe_2O_3)	1·27	1·53
Ferrous oxide	trace.	......
Lime (Cao)	nil	......
Magnesia (MgO)	2·38	2·88
Potash (K_2O)	·74	·89
Soda (Na_2O)	trace.	......
Sulphuric anhydride (SO_3)	30·28	36·66
Insoluble (sand)	17·89	.. ...
	100·44	99·94

Neglecting the insoluble material and calculating to one hundred, the percentages in the right-hand column are obtained, and represent the composition of the mineral more exactly. It differs from typical *pickeringite* in the somewhat lower percentage of magnesia—generally given as four—and the higher percentage of ferric oxide—average below one.

10. *Magnesia-Zinc-Alum from New England.*—Said to occur in a vein twenty feet thick. No specimen is available for description.

An analysis in the Departmental Laboratory afforded the following results —*

Moisture (by difference)	43·51
Alumina ($Al_2 O_3$)	9·36
Ferrous oxide (Fe O)	trace.
Zinc oxide (Zn O)	3·34
Cuprous oxide (Cu O)	trace.
Magnesia (Mg O)	5·78
Soda (Na_2O)	·60
Potash (K_2O)	trace.
Sulphuric anhydride (SO_3)	34·62
Phosphoric anhydride (P_2O_5)	·28
Insoluble	2·51
	100·00

* 94–2108.

11. *Oolitic Iron ore from Pooncarie.*—Pooncarie is situated on the Darling River, between sixty and seventy miles north of Wentworth. The ore is a very dark-coloured hydrated oxide of iron weathering red. The oolitic grains have an average diameter of about half a millimetre. They can be well seen in any part of the ore, but are especially conspicuous on the weathered surfaces. It yielded on assay forty-six per cent. of iron and traces of gold and silver.

XXIII.—On the Occurrence of a Stromatoporoid allied to *Labechia* and *Rosenella*, in the Siluro-Devonian rocks of N.S. Wales: by R. ETHERIDGE, Junr., Curator, Australian Museum.

[Plates XIV—XVI.]

I.—Introduction.

THE very interesting fossil now described as *Labechia* (?) (*Cystistroma*†) *Donnellii*, was presented to the Departmental Collection by Mr. D. C. J. Donnelly, M.L.A. for Cowra, who obtained the specimens at the Belubula River, near Cowra, Parish of Malongulli, County Bathurst. Additional examples were subsequently collected by the Government Geologist (Mr. E. F. Pittman) at the same place.

The essential characters of the fossil seem to agree in the main with those of *Labechia*, Edw. and H., at the same time possessing one of the typical features of *Rosenella*, Nicholson.

The anatomical structure of both these genera has recently been worked out in detail, with great success, by Prof. H. A. Nicholson, M.D.‡ and it is owing to his researches that I have been able to arrive at the following conclusions:—

II.—Form of the Cœnosteum.

The form of this organism is that of oval or subreniform expansions of from two to three inches in thickness, arising from a more or less contracted base, that may perhaps represent a point of attachment. The largest specimen is eleven and a half inches across the under surface, by six inches. The second in size is eight inches by six inches.

The largest example (Pl. XIV, Fig. 1) although presenting as a whole an oval outline, still possesses a more or less flabelliform appearance, and is sub-lobate. The latter feature will possibly account for the two weathered prominences one on each side of the second specimen (Pl. XV).

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* 94/30.

† Gen. nov. (ἡ στισκυ, a bladder, and τὸ στρῶμα, anything spread out.

‡ A Monograph of the British Stromatoporoids.—Part 1,—General Introduction (*Pal. Soc.*, 1886).

The appearance of the original of Pl. XIV, Fig. 1, with its nearly central sub-peduncular prominence, would lead to the belief, if this be a point of attachment, that the cœnosteum had existed as a tabular or horizontal expansion, for it will be observed that the dark lines, representing the radial pillars, radiate in every direction from this centre.

There is perhaps a tendency to a concave base, as in some of the more massive Stromatoporoids; but there is no evidence to show that the organism grew round or overflowed others, as it were, of any material size; nor is there the slightest trace of any tendency towards a dendroid form of growth.

III.—State of Preservation.

The specimens in their present condition are calcareous, and are preserved in a grey-black, impure, fossiliferous limestone. The skeleton represented by the light-coloured portions on Pl. XVI consists of crystalline calcite, whilst the darker portions represent the dense in-filling of the chambers of the cœnosteum, consisting of an impalpable dark mud. The organisms are so very firmly embedded in the hard tough matrix that it has been found impossible to sufficiently relieve them from the latter to permit a proper macroscopic examination to be made, and all that has been gleaned of their outer characters is from weathered surfaces.

The presence of crystalline calcite would seem to point to a replacement of the original tissues. The preservation of our specimens is analagous to that of *Labechia ohioensis*, described by Nicholson*, viz.: "all the interspaces of the fossil have been filled in with a fine-grained greenish calcareous mud, the skeleton having been subsequently dissolved out and then replaced, more or less completely, with transparent calcite." In the present instance not only are the skeletal tissues replaced, but cavities in the infilling matrix are likewise so occupied. There is, however, as in many other Stromatoporoids, no thin margin of crystals lining these vacuities.

IV.—External appearance.

The general appearance of our largest specimen (Pl. XIV, Fig. 1) is that of an organism composed of successive superimposed concentric layers, or floors, better seen perhaps in the weathered-out portions of the example represented in Pl. XV, rather than on the worn down surface of the subject of Pl. XIV, Fig. 1. These layers, however, are by no means found to be regularly continuous when minutely examined, but thicken and thin out at intervals, and it is only by regarding the entire specimen that the apparently concentric structure becomes apparent. In Pl. XIV, Fig. 1, it is the darker portions that represent the skeleton, and the lighter parts the infilling matrix—just the converse of that seen in Pl. XVI. It is, however, only macroscopically that this appearance exists, for when microscopic sections are examined, precisely the same results were obtained as in Pl. XVI. By following the successive lines of dark floors, a festoon-like appearance is

* *Loc. cit.*, p. 30.

observable that at first sight is very puzzling. The result of microscopic examination has been to convince me that this concentric structure is more apparent than real, and even in the more pronounced specimen (Pl. XV, Fig 1) it is, I believe, simply the result of the exposure of the floors by weathering, and partial excavations of the vesicular tissue. In other words the organism does not split up, or peel off in concentric layers, when broken, like so many other Stromatoporoids. There is also visible a regular series of broken lines radiating outwards from the excentric point of attachment (P), which is itself concavely depressed.

In Pl. XV, the only structure visible is that shown on the two weathered lateral patches, which may have been points of attachment and centres of outgrowth. These are, however, interesting, one in particular, for it exemplifies the stratified appearance in natural section, with the radiating lines of pillars passing from one layer to the other, but, at the same time, without any tendency of the latter to peel off. It is by no means a far-fetched resemblance to compare this with the general structure of one of the cylinders of *Labechia stylophora*, figured by Nicholson*

The upper surface of the cœnosteum has not been observed, and so firmly enveloped are the fossils in the matrix, that it has not been found possible to expose it by mechanical means.

Whether or no an *epitheca* existed is uncertain, but there is no trace of such a covering now. Its absence would not be peculiar among the Stromatoporoidea. That *L.*? (*Cystistroma*) *Donnellii* is not an encrusting organism is I think tolerably certain, but it possibly grew after the manner of *Actinostroma* as described† by Nicholson—"in a succession of superimposed strata, applied first to some foreign body and then to one another."

V.—Internal structure.

The internal structure of *L.*? (*Cystistroma*) *Donnellii* is illustrated in Pls. XIV and XVI. In Pl. XVI, Fig. 1 represents a slice taken at right angles to the plane of growth; Fig. 2 another transverse to the same, or "horizontal"; and Fig. 3 parallel to the plane of growth, or "vertical." In Pl. XIV, Fig. 2 is also given a second and better figure of a transverse or horizontal section. The skeleton of this organism consists of a series of radial pillars (*a*) continuous throughout appreciable distances, and running more or less parallel with one another. These radial pillars are united by transverse, straight, curved, or rolling plates, either as fine delicate lines (*b*), or thickened floors (*c*), irregular in their distance apart, some convex upwards, others concave, and where the pillars are wide apart rendering the interspaces highly vesicular (*e*). The vesicles are lenticular, and in places are filled with clear calcite, at others with the fine mud composing the general infilling medium.

* *Loc. cit.*, 1891, Part 3, t. 20, f. 8.
† *Loc. cit.*, 1886, Part 1, p. 59.

The radial pillars.—The size of these supports is very irregular, both as compared with one another in the same specimen, and those of one individual with those of another. No definite evidence has occurred to show that each radial pillar contained an axial tube, nor am I in a position to state what their condition may have been at the full period of growth. In one pillar, however, there is the semblance of two inner walls (Pl. XIV, Fig. 3), as if a tube had originally existed. The absence of this appearance in the other pillars may be only the result of the high degree of alteration the skeletal tissues appear to have undergone. From the same cause it is impossible to say whether or no dark central spots existed in the centre of the pillars marking the position of canals, with a surrounding concentric laminated ring. Neither am I absolutely certain that the pillars are continuous throughout the cœnosteum; but possibly the variability in the length of the radial pillars arises from "the fact that a section never passes along the plane of any one rod for more than a very limited distance."*

The pillars thicken and thin out irrespective of position in the organism. They certainly lack the regularity seen in some species of *Labechia*, for instance, those of *L. serotina*, Nich.†; but, on the other hand, the interrupted condition is observable in the figures of *L. ohioensis*, Nich.‡, and even to some extent in *L. conferta*, Ed. and H.§, itself. In *Labechia* generally, the radial pillars reach their maximum of development amongst the Stromatoporoidea, being exceedingly stout and generally continuous from the epithecate base to the upper surface.‖ I have observed no trace of either cribriform or porous (vacuolated) structure of the skeletal tissues, nor are tabulæ present in any form.

In a transverse section the appearance of the pillars is very peculiar and quite different to anything seen in *Labechia*. Instead of round, concentrically formed, and tubular pillars, we observe (Pl. XIV, Fig. 2; Pl. XVI, Fig. 3) a series of either irregularly placed, or roughly parallel rods, with one diameter generally very much greater than the other. These pillars are asymmetrically stellate, the outline being broken up into a variable number of radiating denticles or spinelets. The longer ones are usually more or less parallel to one another. Here and there are indistinctly seen the cut edges of the vesicular plates connecting the pillars with one another, or the thickened masses of the flooring already alluded to. These points are even better seen in a second tranverse section (Pl. XIV, Fig. 2). Here the almost lenticular form of the radial pillars is very marked, with their strongly-dentate edges, and general parallel direction. Large and irregular masses of calcareous matter, forming the thickened connecting-plates, are also visible. At one point the section has horizontally cut across immediately above one of the floors, possibly armed with the immature pillars, the latter represented by a series of round dots (Pl. XIV, Fig. 6).

* Nicholson, *loc. cit.*, 1886, Part 1, p. 41.
† Nicholson, *loc. cit.*, 1886, Part 1, p. 46, f. 4B.
‡ Nicholson, *loc. cit.*, 1886, Part 1, t. 2, f. 1.
§ Nicholson, *loc. cit.*, 1891, Part 3, t. 20, f. 1.
‖ Nicholson, *loc. cit.*, 1886, Part 1, p. 44.

Connecting Plates.—The connecting-plates present three different appearances—fine hair-like lines (*b*) visible amongst the dark infilling medium; slightly-thickened lines (*c*) where the original plate has undergone a secondary thickening; and again hair-like lines (*d*) in considerable spaces of the vesicular structure of the organism not mud-filled, but simply impregnated with calcite. The interesting point about all these plates, however, is, that whether in the one or the other condition, there is always visible a series of very minute prickles or denticles rising from the upper side of the plates. These are also traceable in places on the sides of the radial pillars, and in their presence we probably have an explanation of the radiating denticles seen on the pillars in cross section.

It might be advanced that these spinelets, as seen in Plate XIV, Fig. 4, were the starting points of new connecting-plates; but their interrupted and radiating nature (Pl. XIV, Fig. 2; Pl. XVI, Fig. 3), together with the fact that they occur in this condition at the same level, seems to dispel such an idea.

Vesicles.—The vesicular structure is very irregular (Pl. XVI, Fig. 1 & 2), arising from the unstable form of the connecting-plates. In some cases the latter extend completely across the inter-columnar spaces, or are "complete," forming a long narrow vesicle; at other times the plates extend only partially across, when they may be termed "incomplete," thus forming an irregular vesicle; or, again, a subsidiary plate may exist, unconnected with the pillar on either side of it, when the so formed vesicle is more or less central. In some instances the vesicles are filled entirely with fine mud, in others with clear calcite, or small vacuities may occur in the impalpable matrix, themselves filled with calcite, and very much simulating the appearance of the connecting pores of some of the higher groups. The true nature of these spaces is, however, proved by the presence of the much more irregular and larger spaces between some of the floors. It is owing, as in *Labechia*, that "to the entirely irregular development of these vesicles, the cœnosteum shows no tendency to split concentrically, as is observed in the normal Stromatoporoids"*

VI.—*Relations to* LABECHIA.

Like that of *Labechia*, the skeleton of the present fossil consists of pillars, irregularly placed; but unlike those of the former, there is, in the present state of preservation, no definite evidence that the pillars contained axial canals, or were cribriform, or possessed a concentric structure. Again, as in *Labechia*, the pillars were connected by a series of transverse plates, which are either curved or straight, and give rise to the formation of a series of large or small vesicles, but as compared with those of *Labechia*, more irregular in outline. This irregularity of development, however, as in the genus named, prevents the tendency to split or peel off concentrically.

* Nicholson, *loc. cit.*, 1886, Part I, p. 81.

As examples displaying the surface have not been observed, the question of terminal tubercles to the pillars may be left out of the question; nor am I in a position to speak as to the presence of an epitheca, but I suspect that one was present.

To sum up, therefore, *Cystistroma* agrees with *Labechia*, using only those characters definitely ascertained, as follows:—

1. In the presence of radial pillars, and their large size.
2. In the presence of connecting-plates.
3. In the presence of interstitial vesicles.
4. In the absence of any tendency to peel off concentrically.
5. Absence of astrorhizæ.
6. „ tabulæ.
7. „ definite zooidal tubes.

On the other hand, *Cystistroma* differs from *Labechia* thus:—

1. Form and more irregular distribution of the radial pillars.
2. Very irregular development of the interstitial vesicles.
3. Presence of short rudimentary growths on the vesicular floors.
4. Presence of similar bodies on the sides of the pillars giving them a more or less dentate appearance in cross-section.

VII.—Relations to Rosenella.

In this genus Prof. Nicholson describes* the cœnosteum as massive or laminar, and the skeleton as consisting entirely of "slightly curved or undulated calcareous plates, which are so combined as to give rise to a series of comparatively large, elongated, lenticular vesicles, upon the convex upper surfaces of which are carried numerous short and rudimentary radial pillars. The radial pillars mostly fall short of the under surface of the lamina next above that from which they spring, and, therefore, appear merely as conical tubercles on the upper surfaces of the vesicular plates."

The passage quoted will at once demonstrate how widely both *Labechia* and *Cystistroma* differ from *Rosenella*, but the remarkable fact still remains that in *Cystistroma* rudimentary projections spring from the vesicular flooring as they do from the laminæ in *Rosenella*. Unlike the rudimentary pillars of the latter, however, they may arise either from a convex or concave vesicle face.

In *Cystistroma* we see well-marked radial pillars that do not occur in *Rosenella*, accompanied by a well-developed vesicular system, apparently more so than in *Labechia*, but less so than in *Rosenella*. In fact, *Cystistroma* appears to be a *Labechia* assuming certain *Rosenella*-like features.

* *Loc. cit.*, 1886, Part. 1, p. 84.

VIII.—Relations to Beatricia.

To this aberrant member of the Labechiidæ, the resemblance of our fossil is comparatively slight, simply in the presence of radial pillars and vesicular tissue. In *Beatricia* the former are much modified and slight. In *Cystistroma* there is not that preponderating influence of the tissue, nor is there any trace of the large axial tube of Billing's genus.

To sum up—Like *Actinostroma*, &c., and contrary to *Stromatopora* proper, *Cystistroma* belongs to the "Hydractinioid" section of the Stromatoporoidea, in which the "radial pillars and concentric laminæ are present as distinct, though closely connected, structures."*

XXIV.—On Blue Dolomite in Lode-quartz: by GEORGE W. CARD, A.R.S.M., F.G.S., Curator and Mineralogist.

A SKY-blue transparent mineral has been several times remarked in the quartz from the Mitchell's Creek Gold-mine, and has been locally regarded as a copper ore. Experiments made upon a fine block of ore presented by the manager, Mr. P. Davies, prove the mineral to be dolomite. This specimen is characteristic of the Mitchell's Creek ore, consisting of white vitreous quartz with patches of iron- and copper-pyrites, the latter sometimes exhibiting the "peacock" tarnish. The quartz is streaked in places by a light-green earthy substance which may perhaps be regarded as chloritic.

The dolomite occupies nests which a very cursory examination shows to be bounded by rhombic outlines, round which the quartz would appear to have moulded itself.

A very small quantity of the mineral was picked out from one of the nests, the comparative lack of hardness and the rhombohedral cleavage being then very apparent. One of the fragments was found to be of a hardness between 3 and 4 of Moh's scale. The small pieces were transparent, and colourless except for a sky-blue (sometimes greenish-blue) band traversing them parallel to one of the cleavage faces at a little distance from the surface. It is this colouration-band which gives the prevailing blue tint to the mineral as seen in mass.

On heating gently the blue colouration disappears and the mineral becomes more or less opaque, assuming a brownish tint. The decrepitation consequent on heating gives rise to very perfect cleavage-rhombohedra. It has been suggested

* Nicholson, *loc. cit.* 1886, Part I, p. 41.

that the blue and greenish tints may be due to *vivianite*, and it may be that the change of colour and loss of transparency on heating are due to per-oxidation of iron. The presence of lime is readily detected by flame tests.

Unattacked by cold dilute hydrochloric acid the mineral is completely soluble with effervescence on warming. By an examination of a very small quantity of the powder, Mr. F. B. Guthrie, F.C.S., has chemically established beyond all doubt the presence of a considerable quantity of magnesia.

It is evident from the above reactions that the mineral is a carbonate of lime and magnesia possessing all the physical properties of dolomite.

In the 1892 edition of Dana's 'Mineralogy' mention is made of a green variety, but there seems to be no record of a blue one.

Mr. F. D. Power, A.R.S.M., F.G.S., informs me that a similar variety occurs at Maldon, County Talbot, Victoria, but that the supply must be nearly exhausted.

In the Mining and Geological Museum there is a small specimen of white vitreous quartz, containing blue dolomite described as coming from Woodford, Victoria, which only differs from the Mitchell's Creek stone in not being mineralised.

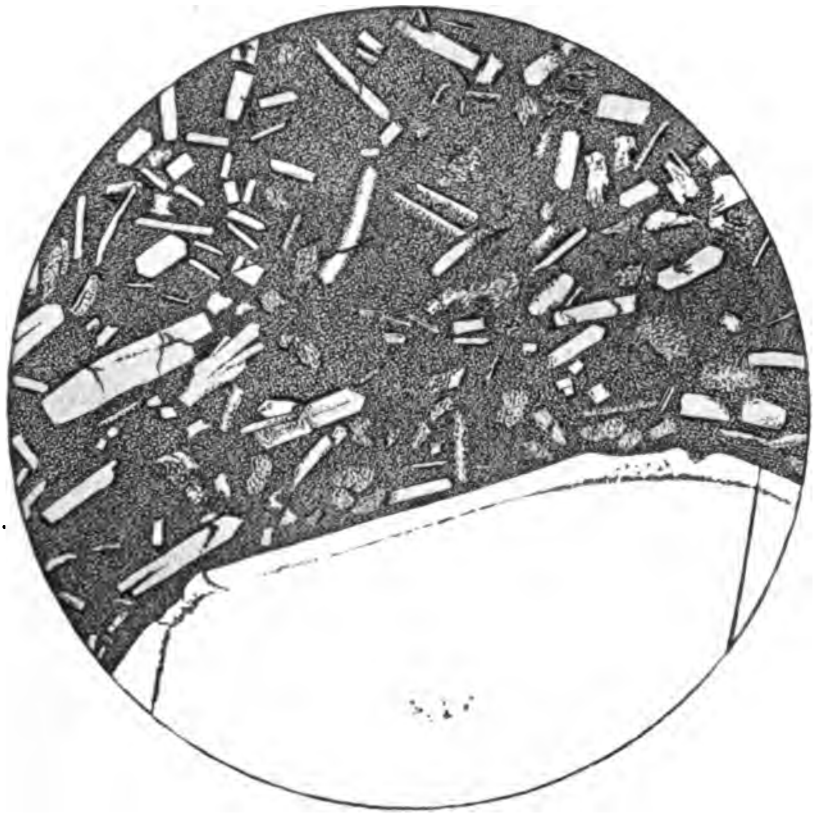
10-16

PLATE X.

A portion of Slide No. 444 in the Collection of the Geological Survey of N. S. Wales—x 62. A corner of one of the porphyritic idiomorphic crystals of felspar is shown. The margin is corroded, and there is a band of inclusions. This crystal is untwinned and quite unaltered, but the polarization effects are irregular.

A number of lath-shaped felspars are embedded in the glass, a few of them exhibiting square sections. The tendency to flow round the porphyritic individual will be noted, as well as the bending and breaking of some of them.

Drawn from nature by Mr. P. T. Hammond.



P. T. Hammond, del. Heliotype.

PLATE XI.

Ornithorhynchus maximus, *Dun.*

Fig. 1. Right humerus, posterior view.
Fig. 2. Do do anterior view.
Fig. 3. Do do articular head.
Fig. 4. Do do articular tuberosity for the head of the radius.

Echidna (Proechidna) robusta, *Dun.*

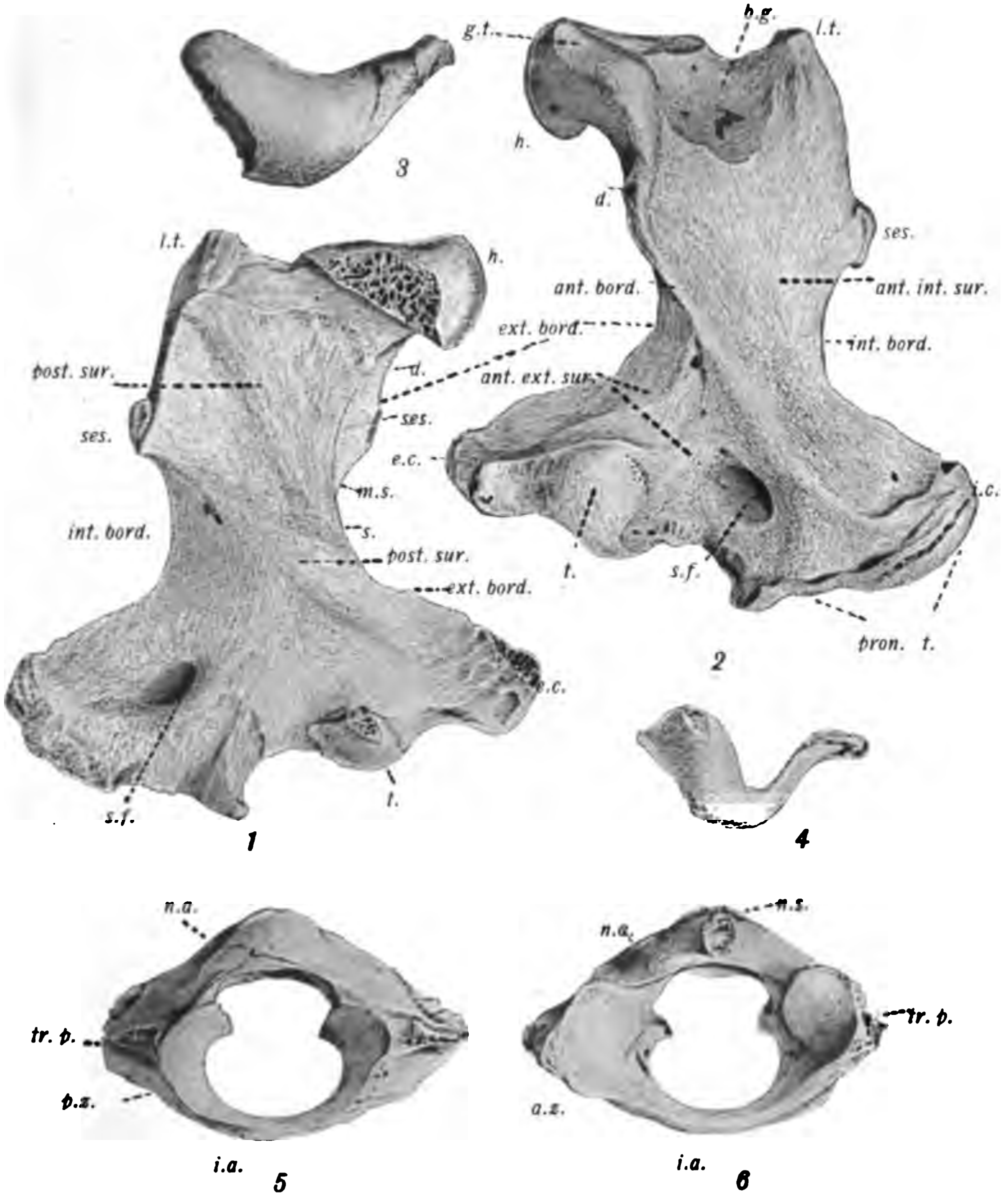
Fig. 5. Atlas vertebra, posterior aspect.
Fig. 6. Do do anterior aspect.

Reference Letters.

Humerus :—*g.t.*, greater tuberosity; *l.t.*, lesser tuberosity; *b.g.*, bicipital groove; *h.*, head; *ses.*, sesamoid; *ant. int. sur.*, antero-internal surface; *int. bord.*, internal border; *ext. bord.*, external border; *pron. t.*, attachment surface of pronator teres muscle; *s.f.*, supracondylar foramen; *e.c.*, external condyle (ectepicondyle); *i.c.*, internal condyle (entepicondyle); *ant. ext. sur.*, antero-external surface; *ant. bord.*, anterior border; *d.*, deltoid ridge; *s.*, supinator ridge; *t.*, trochlea; *m.s.*, musculo-spiral groove.

Vertebra :—*i.a.*, inferior arch; *n.a.*, neural arch; *a.z.*, anterior zygapophysis; *p.z.*, posterior zygapophysis; *n s.*, neural spine; *tr. p.*, transverse process.

Drawn from nature by Mr. P. T. Hammond.



P. T. Hammond, del. Heliotype.

PLATE XII.

Echidna (Proechidna) robusta, *Dun.*

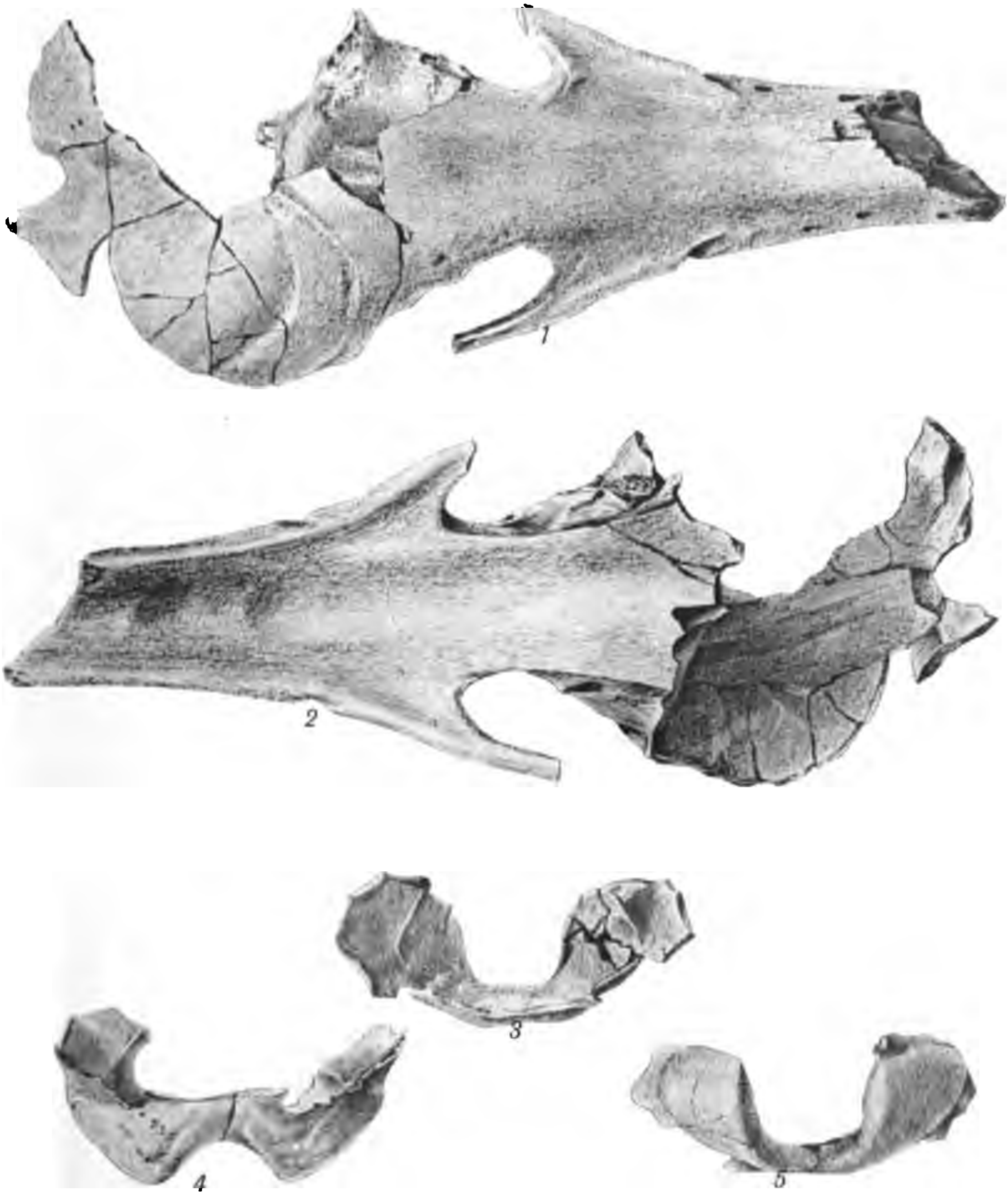
Fig. 1. Portion of cranium and rostrum, upper view.

Fig. 2. Do do lower view.

Fig. 3. View of occipital region of skull, viewed from within.

Fig. 4 and 5. Do do viewed posteriorly.

Drawn from nature by Mr. P. T. Hammond.



P. T. Hammond, del.

Heliotype

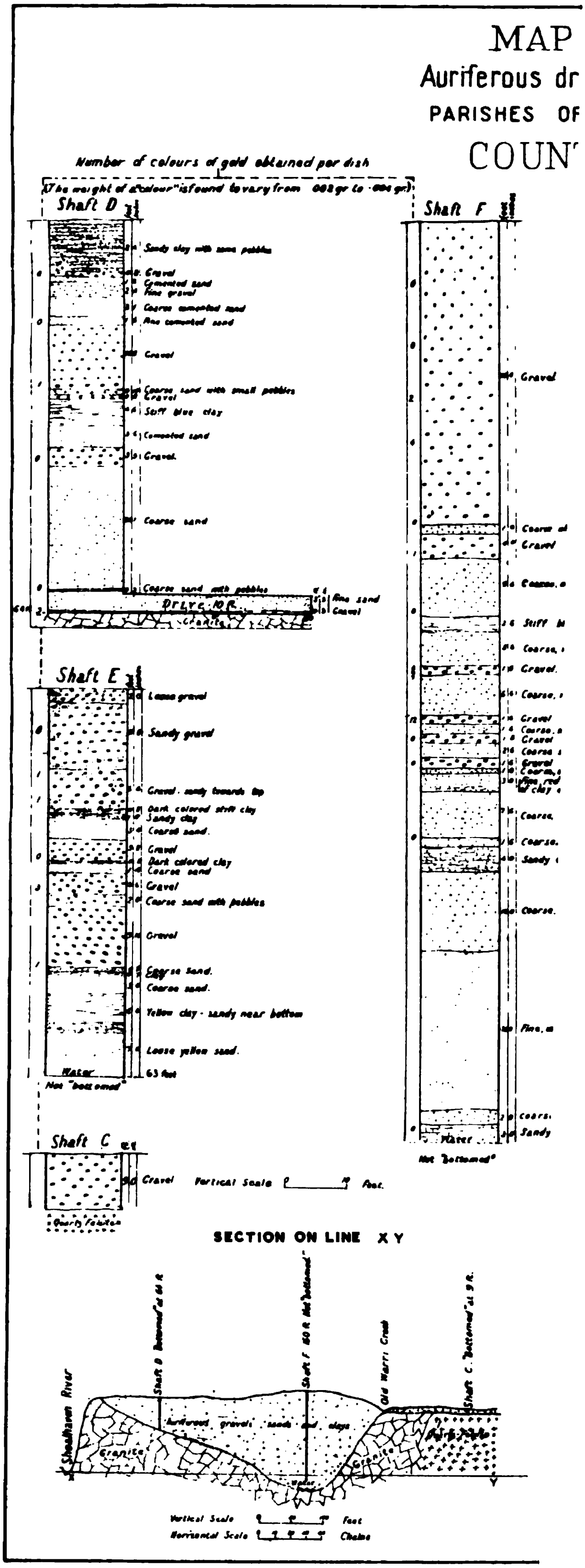
PLATE XIII.

Map of a portion of the Shoalhaven River, Parishes Warri and Jinglemoney, County Murray, showing auriferous gravels, sands, and clays. The bed rock is shown by star-hatching.

Horizontal section on line x y, showing the position of the auriferous gravels, &c.

Four vertical sections, positions shown on the Map by the letters C, D, E, and F.

The scales are shown on the face of the Plate.



MAP
Auriferous dr
PARISHES OF
COUN
Number of colours of gold obtained per dish
(The weight of a "colour" is found to vary from ·002 gr to ·004 gr)
Shaft D
Sandy clay with some pebbles
Gravel
Cemented sand
Fine gravel
Coarse cemented sand
Fine cemented sand
Gravel
Coarse sand with small pebbles
Gravel
Stiff blue clay
Cemented sand
Gravel
Coarse sand
Coarse sand with pebbles
Drive 10 ft.
Fine sand
Gravel
Granite
Shaft E
Loose gravel
Sandy gravel
Gravel - sandy towards top
Dark colored stiff clay
Sandy clay
Coarse sand.
Gravel
Dark colored clay
Coarse sand
Gravel
Coarse sand with pebbles
Gravel
Coarse sand.
Clay
Coarse sand.
Yellow clay - sandy near bottom
Loose yellow sand.
Water
63 feet
Not "bottomed"
Shaft C
Gravel
Quartz Felsite
Vertical Scale Feet
Shaft F
Gravel
Stiff bl
Gravel.
Gravel
Water
Not "bottomed"
SECTION ON LINE XY
Shoalhaven River
Shaft D "Bottomed" at 66 ft.
Shaft F 60 ft. Not "bottomed"
Old Warri Creek
Shaft C "bottomed" at 9 ft.
Auriferous gravels sands and clays
Granite
Granite
Quartz Felsite
X
Y
Vertical Scale Feet
Horizontal Scale Chains

Sig/10 243·94

PLATE XIV.

Labechia ? (Cystistroma) Donnellii, ***Eth. fil.***

Fig. 1. The largest specimen known, showing weathered surface, with radial pillars, connecting plates, and vesicular structure—$\frac{1}{2}$ nat.

Fig. 2. Section at right angles to plane of growth, or "horizontal," showing radial pillars of an elongated form with marginal serrations—nat.

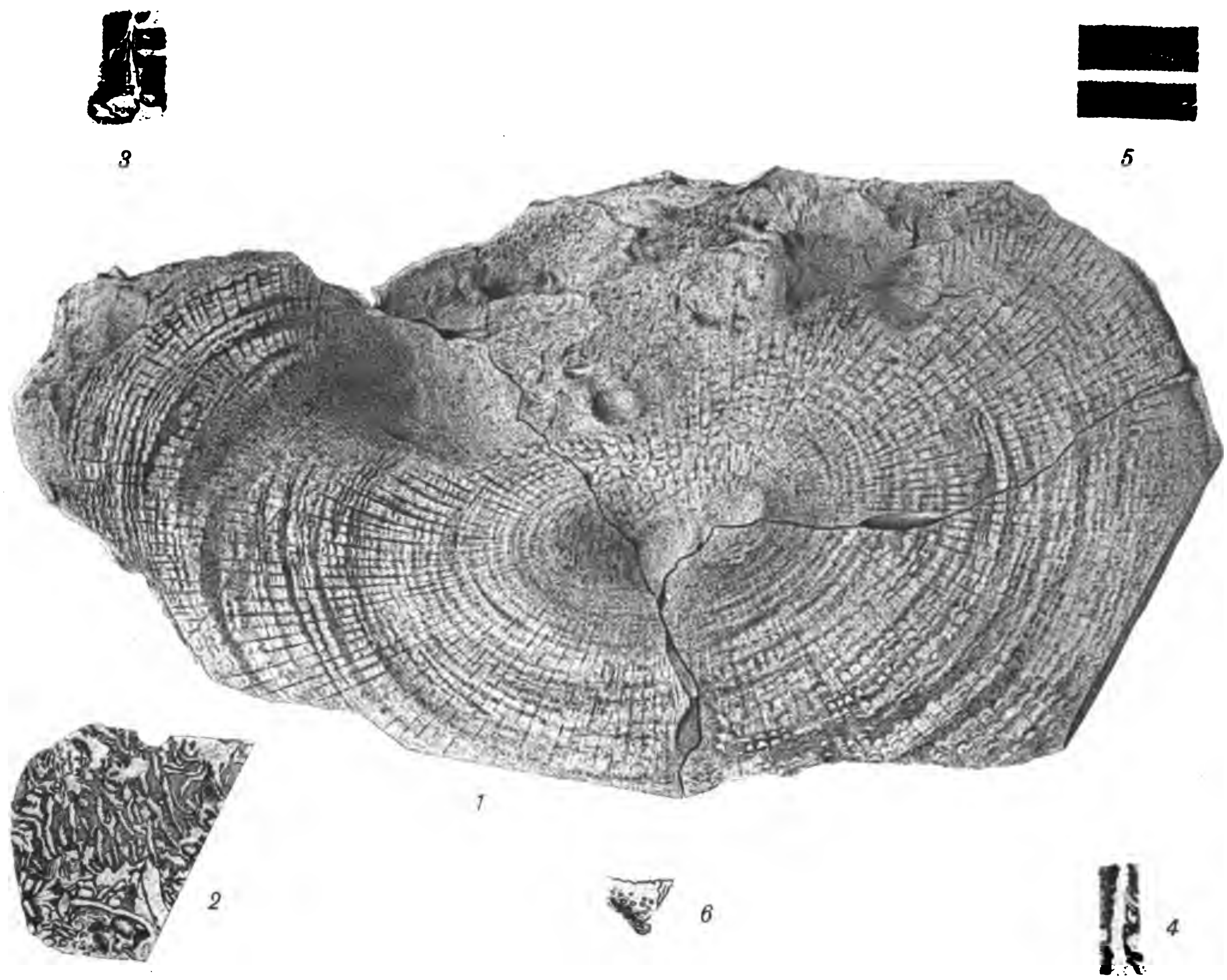
Fig. 3. A radial pillar, seen in vertical section, showing what appears to be an axial tube—nat. This figure is somewhat exaggerated for purposes of delineation.

Fig. 4. A radial pillar, in vertical section, showing marginal denticles—nat.

Fig. 5. Two connecting plates, in vertical section, showing denticles, possibly immature radial pillars—nat.

Fig. 6. Portion of a thickened connecting plate in horizontal section, showing the bases of denticles, possibly immature radial pillars—x 4.

Drawn from nature by Mr. P. T. Hammond.



P. T. Hammond, del.

Heliotype

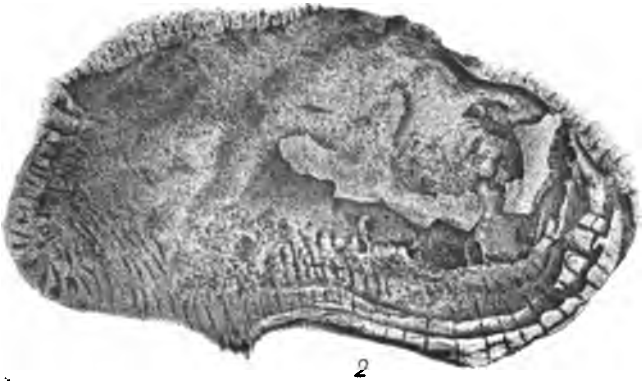
PLATE XV.

Labechia? (Cystistroma) Donnellii, ***Eth. fil.***

Fig. 1. The second largest specimen, with two weathered prominences, perhaps representing points of attachment—$\frac{1}{2}$ nat.

Fig. 2. The upper portion of Fig. 1, approximately enlarged three-quarters.

Drawn from nature by Mr. P. T. Hammond.



2

1

P. T. Hammond, del. Heliotype.

PLATE XVI.

Labechia? (Cystistroma) Donnellii, *Eth. fil.*

Fig. 1. Section at right angles to plane of growth—x 2.

Fig. 2. Section parallel to the plane of growth, or "vertical"—x 2.

Fig. 3. Section transverse to plane of growth, or "horizontal"—x 2.

a. Radial pillars.

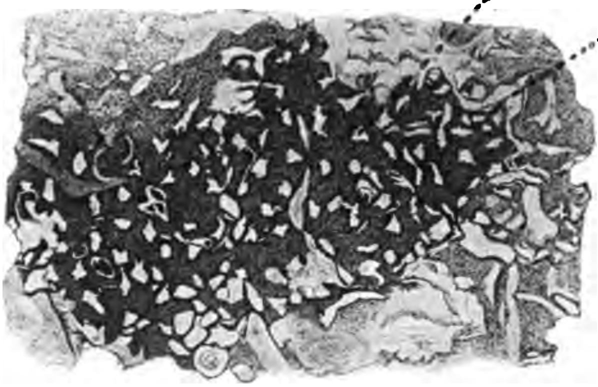
b. Connecting plates as delicate lines.

c. Do do as thickened floors.

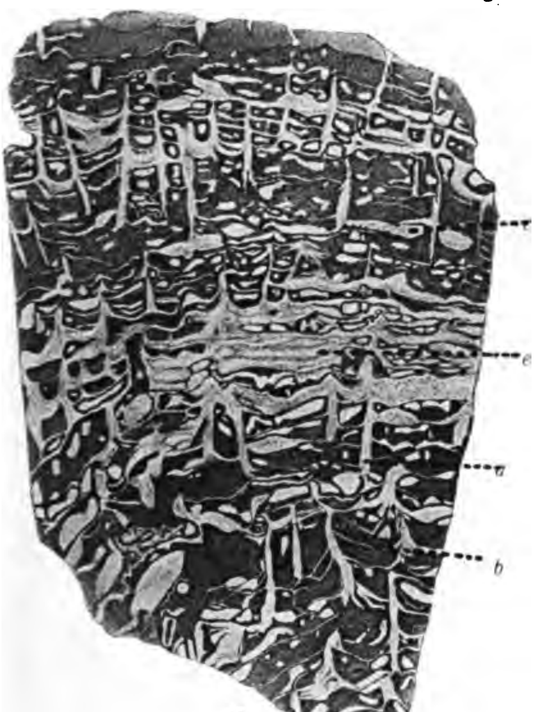
d. Do do as hair-like lines forming vesicular tissue in portions of the organism filled with clear calcite.

e. Highly vesicular structure.

Drawn from nature by Mr. P. T. Hammond.



3



2

1

P. T. Hammond, del.

Heliotype.

Parish, or part of.	Mining District.	Gold-field.
Chalmers (part of)	Peel and Uralla	Upper Hunter (partly).
Churchill do	New England	Solferino.
Clare	Peel and Uralla	Tingha.
Clarence (part of)	New England	Tooloom Creek.
Clifford do	Tumut and Adelong	Umaralla.
Clinton	Bathurst	Ophir.
Clive	Peel and Uralla	Tingha.
Coally (part of)	Albert	Albert.
Cobar	Cobar	Bogan.
Cole (part of)	Bathurst	Newbridge (partly).
Collett	Lachlan	Canowindra.
Colongon	New England	Boorook and Lunatic.
Comlaroi	Clarence and Richmond	Orara.
Cooba	Bathurst	
Coolassin	Tambaroora and Turon	Macquarie River, Stoney Creek, and Ironbarks.
Coolamigal	Bathurst	Turon River.
Coonbaralba	Albert	Albert.
Cooney	Peel and Uralla	Gyra River.
Do (part of)	do do	do
Coorumbung	Hunter and Macleay	
Cope's Creek	Peel and Uralla	Tingha.
Corella	Cobar	Bogan.
Conimaux	Southern	
Corona	Albert	Albert.
Corry (part of)	New England	Boorook and Lunatic.
Coventry	Peel and Uralla	Kookarabooka.
Cox	Bathurst	
Cranbrook (part of)	New England	Emmaville.
Craven	Hunter and Macleay	Gloucester.
Cullen Bullen	Bathurst	Turon River (partly).
Cullendore	New England	
Cummings (part of)	Tambaroora and Turon	Wellington.
Curragurra do	do do	Macquarie River, Stony Creek and Ironbarks.
Currajong do	Lachlan	Billabong.
Curzambene	Southern	Cooloongatta (partly).
Curricki	Hunter and Macleay	Gloucester.
Dalmorton (part of)	Clarence and Richmond	Boyd or Little River.
Danjerra do	Southern	Yalwal.
Darby	Peel and Uralla	Tingha.
Derra Derra	do do	Bingara (partly).
Do (part of)	do do	do do
Dering	Albert	Albert.
Dhoon	do	do
Digby	Peel and Uralla	
Dinoga	do do	Bingara.
Do (part of)	do do	do
Dumaresq	New England	Emmaville.
Dungowan	Peel and Uralla	Peel River.
Dunleary (part of)	Bathurst	Milburn Creek.
Edgar	Albert	Albert.
Ellerslie	Cobar	Bogan.
Elsmore	Peel and Uralla	Tingha (partly).
Enmore	Albert	Albert.
Do	Peel and Uralla	Gyra River Extension.
Eskdale	Bathurst	Clear Creek and Kirkconnell (partly).
Ettrema	Southern	Yalwal.
Euadera (part of)	Tumut and Adelong	Adelong Creek (partly).
Eumur	Peel and Uralla	Ironbarks and Tea-tree.
Eusdale	Bathurst	Kirkconnell and Mount Lambie (partly).
Fairy Hill	Albert	Albert.
Falnash	Bathurst	Turon River (partly).
Fitzroy	Cobar	Bogan.
Flagstone	New England	Emmaville.
Forbes	Lachlan	Billabong and Lachlan, Wellington, Macquarie River.
Do (part of)	Bathurst	Stony Creek, Ironbarks, and Ophir.
Fowler's Gap do	Albert	Albert.
Freemantle do	Bathurst	Ophir (partly).
Fraser	New England	Emmaville.
Do	do	
Gadara (part of)	Tumut and Adelong	Adelong Creek (partly).
Gairdner's Creek	Albert	Albert.
Galbraith	Bathurst	Newbridge and Caloola Creek (partly).
Do (part of)	do	Newbridge (partly).
Gibraltar do	New England	
Giles (part of)	Albert	Albert.
Gillgurry do	New England	Boorook and Lunatic.
Gillenbine	Cobar	Bogan.
Gillindich	Bathurst	Junction Point, Tuena and Markdale.
Glenken	Tumut and Adelong	Ournie Creek.
Gneupa	Southern	Pambula.
Gooloongolok	Hunter and Macleay	Gloucester.
Gordon	Peel and Uralla	
Gouron (part of)	do do	Bingara.
Græme	Hunter and Macleay	Nowendoc and Gl[illegible]
Gulgong	Mudgee	Gulgong.
Gulph (part of)	Southern	Gulph (partly).
Guntawang	Mudgee	Gulgong.
Hall	Peel and Uralla	Kookarabooka.
Do	do	Ironbark and Tea-tree.
Do	do	Bingara (partly).
Do (part of)	do	do
Hamilton	New England	Emmaville (partly).
Hampton	Bathurst	Sofala do
Hanning	Peel and Uralla	
Hargraves	Mudgee	Wellington.
Hartley	Bathurst	
Haystack	New England	Emmaville.
Heathcote	Southern	
Herbert	Peel and Uralla	Tingha.
Harborn	Hunter and Macleay	Orara.
Highland Home	New England	Emmaville.
Hughes	Albert	Albert.
Ironbarks (part of)	Tambaroora and Turon	Macquarie River, Stony Cr[illegible] Ironbarks, and Mu[illegible]
Inverary	Southern	Nerrimunga.
Inverell	Peel and Uralla	
Jamberoo	Southern	
Jamieson	Bathurst	
Jallore	Southern	
Jarricknorra	do	Strathaven and Sh[illegible] River (partly).
Jingellic East	Tumut and Adelong	Ournie Creek.
Joadja	Southern	
Jocelyn	Bathurst	Oberon.
Kahibah	Hunter and Macleay	
Kangaloon	Southern	
Kedumba	Bathurst	
Kembla	Southern	
Kirk	Albert	Albert.
Lake Macquarie	Hunter and Macleay	
Land's End	New England	Emmaville.
Langdale (part of)	Bathurst	Oberon (partly).
Lennox	do	Ophir do
Lewis	Albert	Albert.
Do (part of)	Bathurst	Ophir (partly).
Lidsdale	do	Mount Lambie (partly).
Loftus (part of)	Peel and Uralla	Swamp Oak and Niang[illegible] (partly).
Macintyre (part of)	do do	Bingara (partly).
Maharatta	Albert	Albert.
Mandanah (part of)	Lachlan	Barmedman (partly).
Mandolong	Hunter and Macleay	
Manildra	Lachlan	Dilga.
Marangaroo	Bathurst	
March (part of)	do	Ophir.
Marsh	New England	
Martin	Lachlan	Billabong.
Marulan	Southern	Argyle, Camden, and [illegible]
Maryland	New England	
Mayo	Peel and Uralla	Tingha.
Megalong	Bathurst	
Merrigalah (part of)	Peel and Uralla	Gyra River.
Metz	do do	do
Do (part of)	do do	do
Mickimill	Cobar	Bogan.
Milring (part of)	Albert	Albert.
Mingelo do	Mudgee	Tomingley.
Mitchell	Peel and Uralla	
Do (part of)	do do	Kookabookra and [illegible]
Molroy	do do	Bingara.
Mongarlowe	Southern	Mongarlowe River (partly).
Moonam (part of)	Peel and Uralla	Upper Hunter.
Moorkale	Albert	Albert.
Moquilamba	Cobar	Bogan.

Parish, or part of.	Mining District.	Gold-field.	Parish, or part of.	Mining District.	Gold-field.
[illegible]	Southern	Moruya (partly).	Springbrook	Clarence and Richmond	Boyd or Little River.
[illegible]	Mudgee		Stanford	Hunter and Macleay	
[illegible]	Bathurst		Stephen	Albert	Albert.
[illegible]	Cobar	Bogan.	Stockington	Hunter and Macleay Extended.	
[illegible]	Albert	Albert.	Stockton	Hunter and Macleay	
[illegible]	Cobar	Bogan.	Do (town of)	do do	
[illegible] (part of)	Tambaroora and Turon	Macquarie River, Stony Creek, Ironbarks, and Muckerwa.	Stonehenge	Peel and Uralla	
do do	do do	do do	Stowell	Hunter and Macleay	
[illegible]	Lachlan	Billabong.	Strachan	New England	Emmaville (partly)
[illegible]	New England	Emmaville.	Strathbogie	do do and Peel and Uralla.	do do
[illegible]	Bathurst	Mulgunnia and Abercrombie (partly).	Do North	New England	do do
[illegible] Mundi	Albert	Albert.	Strathspey (part of)	do do	Boorook and Lunatic.
[illegible]	Tumut and Adelong	Black Range (partly).	Sutton	Hunter and Macleay	
[illegible]	Cobar	Bogan.	Swinton	Peel and Uralla	Tingha.
[illegible]	Peel and Uralla	Bingara.	Talbragar	Mudgee	Gulgong.
[illegible]	Albert	Albert.	Tallaganda (part of)	Southern	
[illegible]	do	do	Tambaroora do	Tambaroora and Turon.	Wellington.
[illegible]	Southern	Argyle, Camden, and King.	Tara	Albert	Albert.
[illegible]	Bathurst		Telerarce	Hunter and Macleay	Gloucester (partly).
[illegible] (part of)	Southern	Gulph (partly).	Tenandra	Mudgee	Mitchell's Creek.
[illegible]	do	Nerrimungah Creek.	Tent Hill	New England	Emmaville (partly).
[illegible] England Mining District.			Teralba	Hunter and Macleay	
			Thornshope	Bathurst	Mount Lambie.
[illegible]	Peel and Uralla	Ironbark and Tea-tree (partly).	Tienga	Peel and Uralla	
[illegible]	Hunter and Macleay	Orara.	Timbarra	New England	Boorook and Lunatic, and Timbarra.
[illegible]	Southern	Dromedary.	Tomago	Southern	Mogo (partly).
[illegible] (part of)	do	do	Tomaree	Hunter and Macleay	
[illegible] do	Albert	Albert.	Toogong	Lachlan	Cargo and Canowindra (partly).
[illegible]	Clarence and Richmond	Boyd or Little River (partly).	Topi Topi	Hunter and Macleay	Gloucester.
[illegible] (part of)	Peel and Uralla	Peel River (partly).	Torrorwangee	Albert	Albert.
[illegible]	Clarence and Richmond	Tweed and Richmond Rivers.	Torrens (part of)	Bathurst	King's Plains.
[illegible] (part of)	Southern	Shoalhaven and Shoalhaven River.	Tout	Cobar	Bogan.
[illegible]	Bathurst	Oberon.	Trianbil (part of)	Tambaroora and Turon.	Wellington.
[illegible] (part of)	Peel and Uralla	Upper Hunter.	Trigalong	Lachlan	Temora.
[illegible]	Hunter and Macleay		Tuena	Bathurst	Abercrombie.
[illegible]	Peel and Uralla	Upper Hunter.	Tuggarah	Hunter and Macleay	
[illegible]	Albert	Albert.	Tumbarumba	Tumut and Adelong	Tumbarumba, Murance, and Burra Creek (partly).
[illegible]	Southern	Argyle, Camden, and King.			
[illegible] (part of), Mount [illegible]	Albert	Albert.	Undercliff (part of)	New England	Boorook and Lunatic.
			Undoo do	Tumut and Adelong	
[illegible]	do	do	Umberumberka	Albert	Albert.
[illegible]	do	do	Umarrah (part of)	Tambaroora and Turon.	Wellington.
[illegible] North	New England	Emmaville.	Urabodalla do	Southern	
[illegible]	Lachlan	Billabong.	Walcha	Peel and Uralla	Swamp Oak and Niangala.
[illegible]	Albert	Albert.	Wallah Wallah	Lachlan	Lachlan.
[illegible] (part of)	Peel and Uralla	Upper Hunter	Wallundry	do	Gundabindyal.
[illegible]	Albert	Albert.	Walters (part of)	Tambaroora and Turon.	Wellington.
[illegible] (part of)	New England	Emmaville.	Wangat	Hunter and Macleay	Gloucester.
[illegible] do	do do	Boorook and Lunatic	Warragamba	Bathurst	
[illegible]	Albert	Albert.	Warratra (part of)	Mudgee	Wellington.
[illegible]	New England	Emmaville.	Warre Warral	Tumut and Adelong	Sebastopol, Junee, and Urangilly.
[illegible]	do do	do			
[illegible] (part of)	do do	do	Waukaroo	Albert	Albert.
[illegible] Valley do	Tumut and Adelong	Umaralla.	Wellington North	New England	Emmaville (partly).
[illegible]	New England	Boorook and Lunatic (partly).	Wellington Vale	do do	do do
[illegible]	Peel and Uralla		Wells	Tambaroora and Turon.	
[illegible] (part of)	do do	Kookarabooka.	Wertago	Albert	Albert.
[illegible] do	do do	do	West Fairfield	New England	Timbarra.
[illegible]	Cobar	Bogan.	Willie Ploma	Tumut and Adelong	Adelong Creek.
[illegible]	Peel and Uralla and New England.	Emmaville (partly).	Willyama, (village of)	Albert	Albert.
			Windeyer (part of)	Mudgee	Wellington.
[illegible]	Peel and Uralla		Wonona	Southern	
[illegible]	Tumut and Adelong	Sebastopol, Junee, and Urangilly (partly).	Wongawilli	do	
			Wood's Reef	Peel and Uralla	Iron-bark and Tea-tree.
[illegible]	Albert	Albert.	Woraro	Albert	Albert.
[illegible] (part of)	Peel and Uralla	Kookarabooka.	Worcester	Bathurst	Ophir.
[illegible]	Albert	Albert.	Worra	Peel and Uralla	Kookarabooka.
[illegible] (part of)	Peel and Uralla		Wyaldra	Mudgee	Gulgong.
[illegible] Grove (pt. of)	New England	Emmaville (partly).	Wyanbene	Southern	
[illegible]	Peel and Uralla	Tingha do	Wylie	New England	Boorook and Lunatic (partly).
[illegible]	Tambaroora and Turon.	Turon River.	Yalwal (part of)	Southern	Yalwal.
[illegible] (part of)	Bathurst	Gully Swamp and Black Hills (partly).	Yancowinna	Albert	Albert.
			Do North	do	do
[illegible]	Cobar	Bogan.	Yarralaw	Southern	Argyle, Camden, and King.
[illegible]	Albert	Albert.	Young (part of)	Lachlan	Burrangong.
[illegible]	Southern		Yowaka	Southern	Pambula.
[illegible] Gundagai	Tumut and Adelong	Adelong Creek and Gundagai.	Do (part of)	do	do

GEOLOGICAL MAPS AND PUBLICATIONS ISSUED BY THE DEPARTMENT OF MINES AND AGRICULTURE, SYDNEY.

(1.) MAPS.

Map showing Mineral Areas of New South Wales. Scale, 16 miles to 1 inch.
 Do do do Scale, 60 miles to 1 inch.
Geological Sketch Map of New South Wales, compiled from the Maps of the late Rev. W. B. Clarke, M.A., F.R.S., by C. S. Wilkinson, L.S., F.G.S., Government Geological Surveyor-in-charge. Scale, 8 miles to 1 inch.
 Do do do do Scale, 22 miles to 1 inch.
 Do do do prepared under the direction of E. F. Pittman, &c., &c., Government Geologist. Scale, 16 miles to 1 inch.
Geological Map of the Districts of Hartley, Bowenfells, Wallerawang, and Rydal, by C. S. Wilkinson, L.S., F.G.S.
Geological Map of Hill End and Tambaroora, by E. F. Pittman, Geological Surveyor.
Geological Map of the Vegetable Creek Tin-mining District, by T. W. E. David, B.A., F.G.S., Geological Surveyor. Scale, 58 chains to 1 inch.
Index Map of the Vegetable Creek Tin-fields, by T. W. E. David, B.A., F.G.S. Scale, 80 chains to 1 inch.
Geological Map of the Forest Reefs District, by H. Y. L. Brown, Geological Surveyor.
Map of the Silver-mining Country, Barrier Ranges, by C. S. Wilkinson, L.S., F.G.S.
Vertical Sections of New South Wales Upper Coal Measures, by John Mackenzie, F.G.S., Examiner of Coal-fields.
Diagrams showing the Thickness, Character, and Portion mined out of Coal-seams in the Coal Measures of New South Wales, by John Mackenzie, F.G.S., Examiner of Coal-fields.
Plans showing the Outcrop, Thickness, and Dip of the Coal-seams in the Northern, Southern, and Western Coal-mining Districts of New South Wales, by John Mackenzie, F.G.S., Examiner of Coal-fields.
Geological Sketch Map showing boundary of the Cretaceo-Tertiary Formation in the County of Cowper, by William Anderson, Geological Surveyor, 1889.
Geological Sketch Map of Tertiary Deep Lead, Tumberumba, by William Anderson, 1890.
Sketch Map showing Geological Features between Peak Hill and Tomingley, by William Anderson, 1890.

(2.) PUBLICATIONS.

The Mining Act of 1881, with Regulations.
Annual Reports from 1875 to 1893 inclusive.
Mines and Mineral Statistics, 1875. [Out of print.]

Mineral Products of New South Wales, 1882, containing :—
1. Mineral Products of New South Wales, by Harrie Wood, J.P., Under Secretary for Mines.
2. Notes on the Geology of New South Wales, by C. S. Wilkinson, L.S., F.G.S., Geological Surveyor-in-Charge.
3. Description of the Minerals of New South Wales, by Archibald Liversidge, M.A., F.R.S., F.C.S., F.G.S., &c., Professor of Chemistry and Mineralogy in the University of Sydney.
4. Catalogue of Works, Papers, Reports, and Maps on the Geology, Palæontology, Mineralogy, &c., &c., of the Australian Continent and Tasmania, by Robert Etheridge, Junr., of the British Museum, and Robert Logan Jack, F.R.G.S., F.G.S., Government Geologist for Queensland.

Mineral Products of New South Wales, 2nd Edition, 1886, containing :— [Out of print.]
1. Mineral Products of New South Wales, by Harrie Wood, J.P., Under Secretary for Mines.
2. Notes on the Geology of New South Wales, by C. S. Wilkinson, L.S., F.G.S., Geological Surveyor-in-Charge.
3. The Collieries and Boghead Mineral Mines of New South Wales, by John Mackenzie, F.G.S., Examiner of Coal Fields.

Memoirs of the Geological Survey of New South Wales.

Geology.
1. Report on the Vegetable Creek Tin Mining District, by T. W. E. David, B.A., F.G.S., Geological Surveyor.
5. Geology of the Broken Hill Lode and Barrier Ranges Mineral Field, New South Wales, by J. B. Jaquet, A.R.S.M., &c. (4to. Sydney, 1894.)

Palæontology.
1. The Invertebrate Fauna of the Hawkesbury-Wianamatta Series of New South Wales, by Robert Etheridge, Junr., Palæontologist to the Geological Survey of New South Wales, and Australian Museum, Sydney. (4to. Sydney, 1888.)
2. Contributions to the Tertiary Flora of Australia, by Dr. Constantin, Baron von Ettingshausen, Prof. of Botany, University of Graz, Austria. (4to. Sydney, 1888.)
3. Geological and Palæontological Relations of the Coal and Plant-bearing Beds of Palæozoic and Mesozoic Age in Eastern Australia and Tasmania, by Ottokar Feistmantel, M.D. (4to. Sydney, 1890.)
4. The Fossil Fishes of the Hawkesbury Series at Gosford, by A. S. Woodward, &c. (4to. Sydney, 1890.)
5. A Monograph of the Carboniferous and Permo-Carboniferous Invertebrata of New South Wales. Part 1, Cœlenterata; Part 2, Echinodermata, &c.; by R. Etheridge, Junr. (4to. Sydney, 1891-92.)
7. The Mesozoic and Tertiary Insects of New South Wales, by R. Etheridge, Junr., &c., and A. Sidney Olliff, &c. (4to. Sydney, 1890.)
8. Contributions to a Catalogue of Works, Reports, and Papers on the Anthropology, Ethnology, and Geological History of the Australian Aborigines, Parts I and II; by R. Etheridge, Junr. (4to. Sydney, 1890-92.)

Records of the Geological Survey of New South Wales.
 Vols. I—III (Sydney, 1889-93.); IV, Pts. 1 and 2. (Sydney, 1894.)

DEPARTMENT OF MINES AND AGRICULTURE, SYDNEY.

RECORDS

OF THE

GEOLOGICAL SURVEY OF NEW SOUTH WALES,

VOL. IV, PART IV.

1895.

CONTENTS.

SYDNEY: CHARLES POTTER, GOVERNMENT PRINTER.

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DEPARTMENT OF MINES AND AGRICULTURE, SYDNEY.

RECORDS

OF THE

GEOLOGICAL SURVEY OF NEW SOUTH WALES.

CORRIGENDA.

VOL. IV.

Page 34, line 29. *For* "duocesimcostata" *read* "duodecimcostata"
Page 105, line 27. *For* "Cretaceous" *read* "Lower Mesozoic"
Page 121, line 36. *For* "hystrix, var. aculeata" *read* "aculeata, var. typica"
Page 123, line 28. *For* "hystrix" *read* "typica"
Page 124, lines 27 and 33. *For* "hystrix" *read* "aculeata"
Page 134, footnote. *For* "στισκυ" *read* "κυστις"

several areas of Palæozoic rocks (intruded by dykes of granite, diorite, &c.), which contain deposits of such metals as gold, silver, copper, and tin, and which are flanked or surrounded by Cretaceous or water-bearing sediments, covered in places by drifts and sands of Pleistocene and recent origin.

The examination of this district recently made by me convinces me that the Palæozoic areas shown on our geological map must be considerably reduced, and, that on the other hand the area occupied by the Cretaceous or water-bearing

CORRIGENDA.

Page 125, line 21. For *has* read *have.*
Page 125, line 28. For *has* read *have.*
Page 134, second foot-note. For *στισκυ* read *κμστις.*
Page 134, line 20. For *analagous* read *analogous.*

DEPARTMENT OF MINES AND AGRICULTURE, SYDNEY.

RECORDS

OF THE

GEOLOGICAL SURVEY OF NEW SOUTH WALES.

Vol. IV.] 1895. [Part 4.

XXV.—On the Cretaceous Formation in the North-western portion of New South Wales: by E. F. Pittman, A.R.S.M., Government Geologist.

Previous examinations of portions of this country have been made by Mr. Geological-Surveyor Brown* (now Government Geologist of South Australia) in 1881; by Mr. C. S. Wilkinson,† late Government Geologist of New South Wales, in 1884 and 1887; by Mr. Geological-Surveyor Wm. Anderson,‡ now of the Geological Survey of India, in 1891; and by Mr. Geological-Surveyor J. B. Jaquet,§ in 1892.

Briefly summarised their reports are to the effect that this territory consists of several areas of Palæozoic rocks (intruded by dykes of granite, diorite, &c.), which contain deposits of such metals as gold, silver, copper, and tin, and which are flanked or surrounded by Cretaceous or water-bearing sediments, covered in places by drifts and sands of Pleistocene and recent origin.

The examination of this district recently made by me convinces me that the Palæozoic areas shown on our geological map must be considerably reduced, and, that on the other hand the area occupied by the Cretaceous or water-bearing rocks is much larger than was previously supposed.

* Report upon the Albert Gold-fields, &c., especially with reference to the existence of Artesian Water, &c. Leg. Assembly Paper. (Fscap. Sydney, 1881, by Authority.)

† Ann. Rept. Dept. Mines N.S. Wales for 1884 [1885], pp. 146, 147; *ibid* for 1887, pp. 137–9; Report on Silver-bearing Lodes of Barrier Ranges. Leg. Assembly Paper. (Fscap. Sydney, 1884, by Authority.)

‡ Ann. Rept. Dept. Mines. N.S. Wales for 1891 [1892], p. 254.

§ Ann. Rept. Dept. Mines. N.S. Wales for 1892 [1893], pp. 137–145.

Perhaps the most important conclusion at which I have arrived is that the artesian basin has probably a much further extension *southwards* than had been previously assigned to it. It has hitherto been considered that the southern boundary of the Cretaceous basin was formed by a bar, or buried range of Palæozoic rocks stretching westward from Cobar through Wilcannia to Scrope's Range. At Wilcannia the rocks forming this supposed bar were regarded as *Devonian*, and this opinion appears to have been formed on lithological evidence only, as there is no record of any Devonian fossils having been found in situ, nor of any geological section in which the relation of these Wilcannia sandstones is described with regard to older sediments. But in my opinion the lithological character of these sandstones points to their being of Mesozoic rather than of Palæozoic age, and the small amount of geological evidence that can be obtained from a surface examination seems to strengthen that view. Deposits of hard sediments which I observed at certain localities such as at the west of the Koko Range, at Kooningberry, at the western end of Mount Murchison, at the western side of Woychugga Lake, at the Springs, and at the northern end of Scope's Range, may be and probably are of Devonian age. They consist of hard, dense, thick-bedded quartzites, similar in character to those of Mount Lambie, near Bathurst, showing slickensided joints, and as a rule, lying at a high angle with the horizon. But the rocks at Wilcannia are of a different character. They consist of soft, yellowish, greyish, and whitish grits and sandstones, frequently containing bands and pockets of kaolin, and lying, as a rule, at a very low angle of inclination. In fact while one set of rocks shows abundant evidence of both metamorphism and disturbance, the other is remarkably free from signs of either.

My conclusion in regard to these rocks is, that they are probably of Upper Cretaceous age, and if this be correct it means that, instead of the Cretaceous basin being cut off on the south by an east and west boundary through Wilcannia, there may be a deep channel somewhere between Woychugga Lake and Mount Manara by which the artesian basin may have extended far to the soutwards, possibly even under the Eocene beds of the lower Darling of the north-western portion of Victoria, and part of South Australia to the neighbourhood of Mount Gambier, where fresh water has long been known to escape as springs on the sea-coast, as was first pointed out by the Rev. Tenison Woods.* It is quite possible, however, that this water may be derived from the Eocene beds themselves, and not from underlying Cretaceous beds.

In any case the probabilities of the artesian water-bearing beds, extending southwards from Wilcannia, appear to be strengthened by the occurrence of Upper Cretaceous rocks (Desert Sandstone) at Bidura, near Balranald, as reported by me in June last, and also by the fact that a deep channel has been proved to extend from Urisino (where two fine supplies of water have already been obtained)

* Geological Observations in South Australia. 8vo. London, 1862.

southwards along the west of the Paroo, in the direction of Wilcannia, for I understand that several deep private bores were put down on Momba Station. The deepest of these was 2,000 feet, but I believe that boring operations were discontinued before bedrock was reached.

I propose, during the coming year, to make a geological inspection of the country along the southern course of the Darling, with the object of supplementing the information already obtained; but the only satisfactory way of settling this question is by boring, and I am of opinion that there is sufficient geological evidence to warrant the expense of a series of bores to the south of Wilcannia.

In my journey northwards from Broken Hill, the Upper Cretaceous rocks were first met with at Fowler's Gap, to the north-east of Corona Station. A good section of these beds is seen four miles west of Sandy Creek bore, and also twelve to fifteen miles west of Bancanya bore, where they form the eastern escarpment of the Koko Ranges. They consist of soft, yellowish-grey, sandstone and grits, often showing false bedding, and often stained by peroxide of iron. They are in fact in no respect distinguishable (lithologically) from the sandstones subsequently examined at Wilcannia. On the western flanks of the Koko Range these sandstone beds are seen to lie unconformably on the upturned edges of slate rocks of probably Upper Silurian age. The sandstones here dip to the east at a low angle (about ten degrees), but as they are followed eastwards the dip is seen to increase, until at the eastern side of the range it attains an angle of forty-five degrees. It is unusual to find the Upper Cretaceous rocks as highly inclined as this, but at least one instance of as high a dip as the above has been observed in Queensland, for Mr. W. H. Rands (Assistant Geologist) has measured a dip of forty-five degrees in Desert Sandstone rocks on the Isis River.*

In many other localities as at Milparinka, Mount Poole, Mount Stuart, and in the Grey Ranges, similar soft sandstones—but dipping as a rule at a very slight angle—are met with, and these frequently alternate with, or are sometimes overlaid (conformably) by hard rocks, which, though somewhat of the nature of quartzites, are perfectly distinct from the Devonian rocks previously alluded to. The latter are highly metamorphosed *homogeneous* quartzites, while the Upper Cretaceous rocks appear to be grits which have been altered by thermal springs—they have in fact become opalised or porcelainised by having all the interstices between the sand-grains or pebbles completely filled by silica deposited from solution. One of the characteristics of this porcelainised rock is the manner in which it breaks up on the hill-tops. It is extremely hard but also extremely brittle. It " rings" like porcelain when struck, and breaks with a conchoidal fracture. The prolonged heat of the sun followed by rapid cooling of the surface, owing to thunderstorms and the frosts of winter, causes the larger pieces of stone

* Jack and Etheridge. Geology and Palæontology of Queensland and New Guinea. (8vo. Brisbane, 1892, by Authority.) P. 543.

to exfoliate and break up rapidly, and consequently it is rare to see an outcrop of solid beds—the hill-tops being covered with a more or less rounded shingle like that so characteristic of Sturt's Stony Desert.

Evidences of the agency of thermal springs are frequent in the Upper Cretaceous rocks. At the Peak (Mount Stuart Range) ancient thermal springs have left mounds of curiously-banded limonite, showing that many of them contained ferruginous as well as silicious solutions, indeed the Upper Cretaceous rocks are characterised by the occurrence of considerable quantities of iron oxide.

Near the top of the Upper Cretaceous rocks, in the elevated lands, there is a bed of conglomerate a few inches thick, consisting of pebbles of an infinite variety of colour, and owing to the breaking up of this conglomerate by weathering the lower ground is in many places strewn with highly-polished pebbles of banded agates, chalcedony, jasper, carnelian, pink and white quartz, &c. The extremely high polish which these stones exhibit is probably due to the action of the wind and sand.

The whole of the country between the Waratta Ranges and the Queensland Border is more or less overlaid by these Upper Cretaceous rocks, and they appear to extend for a good many miles to the east and west. In none of the country traversed by me were the Lower Cretaceous rocks (Rolling Downs Formation of Queensland) to be seen outcropping at the surface, there being always a capping of either Desert Sandstone or of Pleistocene sands to hide them from view. But in the spoil-heaps of many of the wells which have been put down by the pastoral lessees are to be seen the characteristic blue clays and sandy shales of the Lower Cretaceous Formation containing *Belemnites*, *Maccoyella reflecta*, *Maccoyella corbiensis*, &c. I also obtained a specimen (presented by Mr. A. Lang) of a very large bivalve, which Mr. Etheridge believes to be new, and Mr. Warden Maitland presented me with a specimen (from the Upper Cretaceous rocks of Mount Stuart) of a fossil tree-fern which is also new to Australia.

Very large tracts of this North-Western District are covered by recent deposits in the shape of "sandhills" and "claypans," and, as these form quite a notable feature in the character of the country, they are worthy of a brief description. They are very extensively developed along the Wanaaring to Milparinka Road, particularly between the Clifton Bore and Milparinka; but patches of them are met with in various parts of the North-Western District. The sandhills, which vary from small mounds to hills of fifty feet in height, are formed of blown sand. In many cases their surfaces are being continually modified by the action of the wind, and as can be easily imagined they make the roads exceedingly heavy for travellers. The sand of which these hills are formed evidently owes its origin to the disintegration of the Upper Cretaceous sandstones. The claypans are flat-bottomed shallow depressions which occur in the neighbourhood of the sandhills.

They vary in depth from a few inches to about three feet, and the floor consists of fine clay upon which the water lies for a considerable time after rain. They are often quite circular in form, while at other times they are seen to form long channels of regular width. It seems probable that they may have been formed by the whirlwinds (the "Burramugga" of the blackfellows) which are of very common occurrence in this country. Some of these whirlwinds remain stationary for a considerable time—which suggests the formation of the circular depressions—while a travelling whirlwind of unusual severity might be expected to sweep up the sand in such a way as to form the long narrow channels. The depressions having been thus formed subsequent rains have carried into them in suspension fine clay washed out of the surrounding sandy soil. When the water has afterwards evaporated by the heat of the sun, or sunk into the floor of the depression, a coating of clay has been left, and frequent repetitions of this process have left a thick floor of clay forming a hard and impervious bed for the water.

One of the most interesting geological features of this district is the occurrence at Mount Browne and Tibooburra of auriferous drifts of Cretaceous age. This was, I believe, first noticed by the late Mr. C. S. Wilkinson, Government Geologist.*

At the Western end of Mount Browne a rounded quartz pebble drift, which has proved to be highly auriferous, and has been extensively worked on a small rise known as Billygoat Hill, dips suddenly beneath the level of the Upper Cretaceous sandstones which surround the Mount Browne Range. This quartz pebble drift takes its rise in the Mount Browne Range (which is composed of Upper Silurian slates with numerous quartz reefs) somewhere near the Four-mile diggings, and it trends, with a gradual fall, in a more or less South-westerly direction for about four miles to Billygoat Hill—on the top of which the drift is seen to be about three to four feet in thickness, lying on rather decomposed slate rocks. From here it is evident that the old Cretaceous creek or river fell over a slate cliff, for in a distance of little more than one hundred yards west the drift has been followed to a depth of two hundred and forty feet in the Mount Browne Gold-mining Company's shaft—operations in which were discontinued owing chiefly to the strong body of water met with.

The gold from the higher portions of this old drift has been re-distributed during later times, and has been worked in shallow deposits in numbers of the small gullies heading from the Mount Browne Range.

At Tibooburra the auriferous Cretaceous drifts dip off an area of granite rocks.

Another instance of gold being found in Cretaceous rocks was observed at a place called the Peak, between Kayunnera and Tarella, on the Milparinka-Wilcannia road. The Peak itself is an isolated conical hill of Upper Silurian slates,

* Ann. Rept. Dept. Mines N. S. Wales for 1884 [1885], p. 137; Records Geol. Survey N. S. Wales, 1889, I, pt. 1, pp. 1–9.

capped (unconformably) by Upper Cretaceous quartz and ironstone conglomerate. In the adjoining hills to the north of the Peak, the conglomerate dips to the north-east under a considerable thickness of Upper Cretaceous sandstone. The tenant of the Peak Government Tank (Peter Riley) has obtained a fair amount of alluvial gold by following the ironstone conglomerate to the dip, and also by working the recent gullies which intersect it, and in which the gold has been reconcentrated.

Opal-mining in Upper Cretaceous rocks at the White Cliffs is still being carried on by about one hundred miners, and there is every reason to suppose that the industry will be a permanent one. The opal is being found in small horizontal and vertical pipes in a soft white rock, which is locally termed kaolin, but which appears to consist mainly of fine silica. A considerable area of ground has been broken in prospecting for opal, but very large areas still remain untouched; and I can see no reason why they should not yield good opal for many years to come. There is no surface indication of the occurrence of the gem, and consequently there is a great deal of the element of chance connected with prospecting operations. Hitherto the bulk of the opal has been obtained at a depth of about twelve feet from the surface, and the workings have mostly been confined to this level, apparently under the impression that it would be useless to look deeper for the stone. I am of opinion, however, that this is a mistake, and that opal may be expected to occur at much greater depths than it has hitherto been found.

XXVI.—On the Occurrence of a Plant in the Newcastle or Upper Coal-measures possessing characters both of the Genera *Phyllotheca*, Brong., and *Cingularia*, Weiss: by R. ETHERIDGE, Junr., Curator of the Australian Museum.

[Plates XVII—XIX.]

I.—Introduction.

MR. J. B. HENSON, C.E., Engineer to the Water and Sewerage Board, Newcastle, has lately been successful in obtaining a number of disjointed plant-remains from the Newcastle or Upper Coal-measures, from the cliff face at Shepherd's Hill, Newcastle, displaying features on the one hand resembling those of *Phyllotheca* Brong., and on the other to some extent those of the genus *Cingularia*, Weiss. The latter is a plant of doubtful systematic position found in the Saarbrück Coal-field, but believed to be allied to the Calamitidæ.

In addition to Mr. Henson's plants, a single peltate infundibuliform leaf (?) was obtained in the Cremorne Bore No. 1, Robertson's Point, Port Jackson, at a depth of 2,900 feet, also an horizon in the Upper Coal-measures.

The specimens collected by Mr. Henson consist of compressed stems, branches, whorls of leaves, and verticillate bracts (?) *in situ*. These have been generously presented to the Departmental Collection by the discoverer.

II.—Geological Position.

The plant-bed at Shepherd's Hill consists of a grey to cream-coloured shale immediately underlying the cap of the cliff, a thick conglomerate, and about two hundred and forty feet above sea level. Between the latter and the shale in question are four coal seams (Pl. XIX).

Sir F. McCoy speaks* of the "whitish clay beds of Mulubimbah," as furnishing his specimens of *Phyllotheca*. Mulubimbah is the native name for the Newcastle District, and I am led to believe that his *Phyllothecæ* were derived either from the same bed as Mr. Henson's, or from an extension of it.

III.—Description of the Plant-remains.

Stems.—The longest stem preserved is six inches, and like all the other fragments is divided into nodes and internodes. The nodes are generally speaking from half to one inch apart, and but little enlarged above the diameter of the internodes. In their present compressed state the stems vary in width, but the broadest observed is three-quarters of an inch (Pl. XVIII, Fig. 2). There are six internodes distinctly visible within the measurement above given. The surface of the stems is longitudinally costate, the costæ now being flat, but in their perfect state were probably slightly convex. They are opposite to one another in contiguous internodes, each costa, therefore, being continuous throughout a stem. No absolute connection has been seen between the stems and branches, but they occur together to the exclusion of other plants. In two instances the peculiar tubercles or discs seen on *Equisetum* stems occur, and which Schimper speaks† of as liberated diaphragms consequent on maceration. They have also frequently been figured on the stems of *Phyllotheca*, although these discs were not preserved on the original specimens of this genus so ably described‡ by Sir F. McCoy, who also noticed the continuity of the costæ in *Phyllotheca*. No better illustration of these in *Phyllotheca* can be given, than certain figures of Heer's *P. sibirica*.§

Leaves.—The leaves are chiefly scattered over the surface of the shale hand-specimens, but in a few instances are attached to the leaf sheaths (Pl. XVIII, Figs. 4 and 5). The latter are short, and in a few instances are attached to the stems,

* Ann. Mag. Nat. Hist., 1847, XX, p. 153.
† Zittel's Paléontologie. Pt. II Paléophytologie (French Edit.), p. 153.
‡ Ann. Mag. Nat. Hist., 1847, XX, p. 156.
§ Flora Foss. Arctica, IV, Pt. 2, t. 4, f. 1—5.

which they completely encircle in a subinfundibuliform manner. They are long-linear, completely separated to the sheath edges, uninervate, curve obliquely outwards, and are sharp pointed distally. There are at least twenty in every verticil, and possibly more. Each verticil appears to reach from node to node, and even beyond, so that the stems are wholly clothed, or enveloped in leaves.

So far, this is precisely the structure seen in *Phyllotheca*. A reference to McCoy and Dana's figures, by far the best yet published of the Australian *Phyllothecæ*, will demonstrate this. McCoy says *—"the joints surrounded by sheaths, and the free edge of each sheath terminating in a whorl of long, linear leaves." By Brongniart, the stems of aged individuals of the generic type, *P. australis*,—were described† as smooth between the sheaths, but McCoy has shown ‡ that one of his species (*P. ramosa*) resembles this type, the other having coarsely sulcated, and longitudinally ridged stems (*P. Hookeri*). He further describes the leaves as long and narrow, with a more or less distinct mid-rib. The naked stems amongst our specimens, I cannot do better than compare with the similar examples figured § by Dana, as *Phyllotheca*, sp., and those fragments with leaves attached, referred by him to *P. australis*, Brong., both of which it seems to me are referable to *P. Hookeri*, McCoy. Dana's measurements also agree excellently with those of our examples, one of his being six and a half inches long, and half an inch broad ||.

Peltate Leaves (*or* "*Bracts*"?)—The largest proportion of the Newcastle specimens consist of peltate infundibuliform leaves (?) lying about on the shale surfaces in all conditions and positions (Pl. XVII, Figs. 1–5, 7–9; Pl. XVIII, Fig. 3), many of them very perfect, and attached to branches having the same general characters as the stems. These leaves, if that be their nature, spring from a sheath enclosing the branch, like the linear leaves. This encircling sheath, before the expansion of the peltate leaf commences, is about two-eighths of an inch long. The organs themselves form an inverted umbrella-like expansion, circular at the periphery, and there extended into a series of tooth-like projections or spikes, the re-entering spaces between being concave. It is difficult to give the exact number of these projecting points in each leaf, but probably more than thirty exist in fully-matured examples, as twenty-three have certainly been counted. The surface is slightly, but very regularly crumpled transversely, after the manner of a fan. Many specimens spread open during fossilisation enable the size of these interesting organs to be determined, the largest measured having a diameter of one and a quarter inches. In some few instances the encircling

* Ann. Mag Nat. Hist., 1847, XX, p. 153.
† Prodrome Hist. Vég. Foss., 1828, p. 152.
‡ Ann. Mag. Nat. His., 1847, XX, p. 157.
§ Wilkes U.S. Expl. Exped. Vol. X, Geology, 1849, Atlas, t. 14, f. 2.
|| Wilkes U.S. Expl. Exped. Vol. X, Geology, 1849, p. 719.

depression of attachment is shown (Pl. XVIII, Fig. 3). Each expansion is traversed by radiating costæ (or nerves ?), one to each denticle, whilst each intercostal space bears a faint groove or depression, corresponding to each re-entering angle between the costæ. The intercostal spaces are also crossed by the finest possible transvere striæ, arranged in a festoon-like manner.

For a *possible* elucidation of these peltate organs we may profitably study the structure of the genus *Cingularia*, Weiss. In *Cingularia* the stem is jointed or articulated like those of *Calamites* or *Equisetum*, divided into nodes and internodes, and longitudinally sulcate. The branches are opposite, or arranged in a verticil around the nodes, longitudinally striate like the stems, and bear the leaves and spike-like fructification. The foliage is also arranged in a verticillate manner the leaves being free to their bases. Each leaf is long, linear-subulate, and is traversed by a median nerve. The fructification of this plant is very remarkable. It is pediculate and spike-like, terminating the lateral branches above the foliage-bearing portion, but its component parts have been differently interpreted by writers.

According to Schimper*, the fructification is verticillate, consisting of from fourteen to twenty horizontal, longitudinally striate, unilamellar, linear, cuneate bracts, each segment in the young state ending in a point, and then at maturity becoming truncate and inbent. There is also a transverse sulcus toward the distal end, before and behind which is a scar representing the attachment of a sporangiophore.

On the other hand, Weiss,† who appears to have studied *Cingularia* more than any other writer, believes that the verticillate bracts, instead of forming a single lamina, present a double one. The upper lamina of the verticil is formed of united bracts, deeply incised at the margin, which thus becomes serrate, the serrations agreeing in number with the bracts. This lamina then assumes an inverted umbrella-like appearance and naturally corresponds to the young state of Schimper's single verticillate lamina. The wedge-shaped and sporangiophore-bearing bracts, Schimper's mature state, according to Weiss, form second laminæ *below* the above. He describes the cicatrices on these bracts as four in number—two before and two behind the transverse furrow—and corresponding to the points of insertion of four discoidal sporangiphores. In other words, the upper or inverted umbrella-like verticil is sterile; the lower or horizontal, fertile.

These peltate organs in our specimens do not appear to have any connection with the peculiar bodies figured by Mr. Seward‡ as possibly connected with *Phyllotheca.*

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* Traité Pal. Vég., 1874, III, p. 460.

† Abhandl. Geol. Specialkarte Preuss, 1876, II, Heft 1, p. 88.

‡ Cat. Mesozoic Plants Brit. Mus., 1894, t. 1, f. 7.

IV.—Relations with Phyllotheca and Cingularia.

Our plant remains, omitting the peltate verticillate organs, are to all intents and purposes *Phyllotheca*, agreeing with the latter in all other particulars, and approximating closely to *P. Hookeri*, McCoy. So far as I am aware, no such organs have ever been figured in connection with *Phyllotheca*, and there is in consequence only one of two logical conclusions we can come to—either that these peltate verticillate organs are an advance on the structure of the genus in question, or we are dealing with a plant new to Australian Palæobotany, but possessing many of the features of *Phyllotheca*.

The resemblance between the organs in question and the sterile bracts of *Cingularia*, following Weiss, is very marked. Here, however, the resemblance ceases, for, supposing our plant to be allied to the latter, it is very strange that amongst the large number of examples collected by Mr. Henson, not a vestige of a fertile bract, assuming them to be of this nature for the sake of argument, has come under notice, either underneath the sterile bracts or casually on the surface of any of the shale hand-specimens. At the same time, this is simply on a par with some of Weiss's figures, in which he illustrates spikes made up of the fertile bracts, and none of the sterile. Yet, again, in most of his illustrations fragments of one or the other are found lying in contiguity to the parent specimen. Such is not the case, however, in our specimens, and under the circumstances it appears idle and out of place to refer our remains to *Cingularia* pure and simple.

This opens up the question,—Under what name are these organs to be described?—leaves, or a structure accessory to fructification. In the light of *Cingularia*, one would be inclined to accept the latter solution. On the other hand, from what is known of the fruiting of *Phyllotheca* in other parts of the world—bearing in mind no Australian form has been *satisfactorily* described in this condition—due weight must be given to the former supposition.

McCoy was, I believe, the first to draw attention* to a possible inflorescence in *Phyllotheca*, and this is the only Australian instance known. He describes a portion of a branch, having the sheaths "fringed on their upper margin with a dense little whorl of (I think two-celled) anthers." Schimper,† strange to say, ascribes to McCoy quite an erroneous statement, to the effect that the "fructifications (d'après McCoy) semblable à celles des *Equisetum*." As a matter of fact, McCoy's reference was to the male flowers of *Casuarina*. In McCoy's illustration there is certainly a general resemblance to the fructification of *Annularia* given by Renault‡, in which the sporangiophores are represented midway between the nodes. Bunbury also considered§ that the "catkin" figured by McCoy was allied to that of *Asterophyllites* and *Annularia*.

* Ann. Mag. Nat. Hist., 1847, XX, p. 156.
† Zittel's Paléontologie. Pt. II, Paléophytologie (French Edit.), p. 157.
‡ Cours de Bot. Foss., 1882, II, t. 21, f. 1.
§ Quart. Journ. Geol. Soc., XVII, p. 338.

Zigno says* that the inflorescence of *Phyllotheca* is verticillate at the extremities of the branches, and believes that McCoy's figure recalls much more the amentum of an *Equisetum* than the flowers of a *Casuarina.*

Schmalhausen again differs from McCoy in the interpretation of the Australian fossil. At the same time Schmalhausen figures† three entirely different kinds of fructification ascribed to *Phyllotheca deliquescens*, Goeppert. One‡ is spikelike. A third§ representation is also given by Schmalhausen of a totally different character. Count Solms-Laubach,‖ in criticising these figures, remarks of the second¶ that it represents organs on the internodes situated between the sheaths like the sporangiferous peltate discs of *Equisetum.* He appears to consider the third in much too bad a state of preservation to permit an opinion to be passed upon it. The Count adds:—"Since the specimens have both of them the characteristic foliar sheaths of Phyllotheca, it seems unreasonable to doubt whether they belong to that genus, which would thus differ from true Equisetaceæ in having its fertile spikes repeatedly interrupted by ordinary vegetative leaf-whorls."

The late Prof. Heer figured** the inflorescence of his *Phyllotheca sibirica* in the form of spikes, in the first instance apparently with justification. Count Solms-Laubach says that two others,†† from their association with the remains of *Ginko*, Heer thought were like those of that genus, but the former writer‡‡ believes that Heer is not justified in that view, from mere association.

Lastly, speaking§§ of *Phyllotheca*, Renault says that the spike is verticillate, and the sporangia arranged under peltate bracts; but I do not know his authority for this statement.

The foregoing quotations will at once indicate on what an unsatisfactory basis the evidence of fructification in *Phyllotheca* rests, and that with the exception of McCoy's figure nothing whatever is at present known of that of the Australian forms. His illustration certainly differs widely from either Schmalhausen or Heer's conception of this portion of the plant. That the former has figured more than one kind of fructification under this name is, I think, unquestionable, a fact that also appears to have struck Prof. Heer.‖‖

After all, to us in Australia, *Phyllotheca* is at present little more than a generic name applied to jointed, and more or less costate, stems and branches, the latter springing from above the stem-joints, and bearing linear, verticillate leaves, with a central vein, free distally, but joined into a sheath proximally, and either erect or

* Flora Foss. Form. Oolithicæ, I, pp. 54, 56.
† Jura Flora Russlands, 1879, Pt. I, t. 1, f. 3 and 17; Pt. 3, t. 9, *f.* 16, 16*a*.
‡ *Loc. cit.*, t. 1, f. 3.
§ *Loc. cit.*, t. 9, f. 17.
‖ Fossil Botany, 1891. English Ed. by Garnsey and Balfour, p. 181.
¶ Schmalhausen, *loc. cit.*, t. 9, f. 16, 16*a*.
** Beiträge Foss. Flora Sibiriens, &c., 1878, Pt. I, t. 1, f. 15.
†† Flora Foss. Arctica, VI, t. 1, f. 5.
‡‡ Fossil Botany, *loc. cit.*, p. 181.
§§ Cours Bot. Foss., II, p. 146.
‖‖ Flora Foss. Arctica, VI, p. 9.

reflexed. As the name *Phyllotheca* was originally described from Australian material, it follows that the genus must derive its distinctive characters from such, and whatever the fructification eventually proves to be, so will Foreign species fall within it, or be relegated to other genera. Following Weiss's conception of *Cingularia*, it may perhaps be deduced that the peltate organs from our Upper Coal-Measures are but the sterile bracts of *Phyllotheca*. At the same time the imperfect evidence at command does not warrant a decided opinion. All that we can say with certainty is, that these bodies are in this instance associated with other remains that we have been accustomed to regard as those of *Phyllotheca*, to the exclusion of any other plant-remains, except leaves of *Glossopteris*. The general appearance of Mr. Henson's specimens would lead one to relegate them to *P. Hookeri*, McCoy.

With the exception of Weiss's figures of *Cingularia*, the only other figure known to me at all like the peltate organs from our Upper Coal-Measures is one given by Fontaine in his "Potomac or Younger Mesozoic Flora,"* although much smaller in size, that he considers may possibly be a sheath of an *Equisetum* compressed vertically. It possesses most of the characters exhibited by our specimens.

To sum up, the following points are worthy of being noted:—

1. In world-wide *Phyllothecæ* there have been at least three forms of fructification described.
2. With the exception of McCoy's figure, the fructification of Australian species is unkown.
3. In our Upper Coal-Measures occurs a plant, to all intents and purposes a *Phyllotheca*, possessing peltate organs identical in structure with the sterile bracts of *Cingularia*.
4. This plant seems to be closely allied, if not identical, with *Phyllotheca Hookeri*, McCoy.

XXVII.—On some Rock-Specimens from the Auriferous Granite at Timbarra: by GEORGE W. CARD, A.R.S.M., F.G.S., Curator and Mineralogist.

OWING to the exceptional interest pertaining to the occurrence of gold in granite, the results obtained by the Author in examining a small collection of rocks from the Timbarra Gold-fields may not be unworthy of record.

This collection comprises a series of granites and eurites collected by Mr. Thomas Horton, and submitted for examination to the Geological Survey Branch.

* Mon. U.S. (Powell's) Geol. Survey, 1889, XV, Atlas, t. 173, f. 11, 11a.

The Timbarra Gold-fields are situated on a granite table-land four hundred and ninety miles north of Sydney and twenty miles south of Tabulam. A general geographical description of the district will be found in the first volume of these Records, pp. 43, *et seq.* Where the granite has become soft by atmospheric weathering it is excavated for sluicing. Any undecomposed portions are left standing in large masses. The free gold is very fine, but as much as five pennyweights of gold to the ton is said to have been saved by sluicing decomposed portions of the granite when containing pyrites. Assays of similar stone yield gold at the rate of nine pennyweights. The granite is traversed by a few small veins of auriferous quartz.*

The series comprised fifteen specimens of granite and eurite, the former coming from Surface Hill, Timbarra, and the latter principally from a dyke five miles further west.

The numbers attached to the descriptions are those under which they are registered in the Departmental Collections. The numbers in square brackets refer to the micro-slides.

Although not all gold-bearing themselves, Nos. A 244 to A 251 are described as coming from auriferous areas.

A 244 [574]. Country Rock, at Surface Hill. A pink granite of medium grain, unaltered and quite normal in character. The minerals present are quartz, felspar, and mica; the latter not very abundant. Quartz is abundant, and is traversed by the usual lines of enclosures. The felspar is clouded. With the exception of a few crystals, it is all simply twinned.

A 245 [577]. From Surface Hill. An unaltered flesh-coloured granite. The weathered side of the specimen is constituted by a vein of quartz, in the cavities of which are imbedded little nests of molybdenite. The minerals present are quartz; felspar, much clouded, a good deal of it repeatedly twinned; and certain alteration products which may represent mica. The glass inclusions in the quartz contain fixed bubbles of large size. On assay it yielded—Gold 18 dwt. 8 gr. per ton; silver, 3 dwt. 6 gr. per ton.

A 246 [578]. From Surface Hill. A much decomposed but coherent granite. The specimen is about one and a half inches thick, and is bounded by parallel sides. It is traversed obliquely by a vein of translucent quartz. This vein is very irregular and contains mica; the average width is three-quarters of an inch. The constituents are quartz, and orthoclase and plagioclase felspar. The felspar is much clouded, and has partially recrystallized. On assay it yielded neither gold nor silver.

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* Further details will be found in the Ann. Report Dept. Mines N. S. Wales for 1889 [1890], pp. 201, 202.

A 247. From Surface Hill, from a depth of twenty feet. A very crumbly granite. It contains quartz, pale flesh-coloured felspar, still retaining a slightly vitreous lustre, and a few crystals of dark-green mica. Much pale-green soft material occurs with the products of decomposition of the felspar. On assay it yielded neither gold nor silver.

A 248. From Surface Hill, from a depth of one hundred feet. A crumbling, somewhat fissile granite, the divisional planes being coated with white decomposition products. It consists of quartz; felspar, kaolinised, but with the lustre not altogether lost; dark-green mica; and greenish material, as in A 247. On assay it yielded neither gold nor silver.

A 249. From Surface Hill, from a depth of twenty feet. A pink-coloured rotten granite, consisting of quartz, decomposed felspar, and greenish mica. On assay it yielded—gold, 4 dwt. 8 gr. per ton; silver, 2 dwt, 4 gr. per ton.

A 250. From Surface Hill, from a depth of one hundred feet. A pink somewhat crumbly granite. It consists of quartz, and felspar simply twinned, considerably decomposed, but with its lustre not much impaired. On assay it yielded neither gold nor silver.

A 251 [567]. From Surface Hill. A dull-pink unaltered granite. It consists of quartz; orthoclase, and plagioclase in smaller crystals, both considerably altered; and patches of a pleochroic green substance that may perhaps represent mica. On assay it yielded neither gold nor silver.

A 252. From Surface Hill. A very crumbly, white, fine-grained granite or eurite. The felspar is much decomposed, and but little or no mica is present. This rock is described by the sender as a dyke cutting across the belts of auriferous granite without fault. The granite is said to be auriferous only to the north of it, although its character is the same on each side. On assay it yielded—gold, 7 dwt. 14 gr. per ton; silver, 3 dwt. 6 gr. per ton.

A 253 [575]. From Surface Hill. Country rock similar to A 250. Much plagioclase is present, both it and the orthoclase being much altered. A little greenish mica occurs, together with greenish earthy decomposition products. On assay it yielded neither gold nor silver.

A 254 [576]. From Surface Hill. Similar to A 253, but somewhat more coarsely crystallized. On assay it yielded neither gold nor silver.

A 255. Pegmatite from a dyke five miles west of Timbarra, consisting of quartz and pink orthoclase associated pegmatitically. On assay it yielded neither gold nor silver.

A 256 [595]. Adjoining A 255, from the same dyke. A pale cream-coloured eurite containing nests of a sulphur-coloured micaceous mineral and of arsenical and iron pyrites. The felspar is so far decomposed as to give rise to a white powder where the rock is bruised, and is much iron-stained. The quartz and felspar are graphically associated. On assay it yielded neither gold nor silver.

A 257. Adjoining A 256, from the same dyke. A cream-coloured eurite with nests of a greenish-yellow mica. Two assays* were made which yielded respectively :—

1.	Gold	2 oz. 12 dwt. 6 gr. per ton.
	Silver	15 ,, 2 ,, ,,
2.	Gold	5 ,, 10 ,, ,,
	Silver	2 ,, 4 ,, ,,

No gold was visible in this or any of the specimens.

A 258. Adjoining A 257. A eurite in which blebs of quartz are embedded in a matrix earthy-white where bruised, otherwise greenish yellow. Nests of white mica and of a greenish-yellow micaceous substance and of arsenical pyrites occur. With the microscope a tendency to micropegmatitic structure is noticeable; the mica is seen to occur in wisps, and the felspar is to a large extent replaced by a somewhat fibrous doubly-refracting substance. On assay it yielded neither gold nor silver.

Only four of these specimens were auriferous in themselves, although others were described as coming from auriferous areas. To summarize the results:—

A 245. Unaltered granite ; Surface Hill. (A vein of quartz carrying molybdenite present):—

Gold	18 dwt. 8 gr. per ton.
Silver	3 ,, 6 ,, ,,

A. 249. Rotten pink granite ; Surface Hill. Depth, 20 feet :—

Gold	4 dwt. 8 gr. per ton.
Silver	2 ,, 4 ,, ,,

A 252. Very crumbly eurite. Dyke cutting the auriferous granite without fault :—

Gold	7 dwt. 14 gr. per ton.
Silver	3 ,, 6 ,, ,,

A. 257. Cream-coloured eurite, from a dyke five miles west of Timbarra :—

1.	Gold	2 oz. 12 dwt. 6 gr. per ton.
	Silver	15 ,, 2 ,, ,,
2.	Gold	5 ,, 10 ,, ,,
	Silver	2 ,, 4 ,, ,,

The rocks represented by these specimens are thus seen to consist of a normal granite, generally pink or flesh-coloured, traversed by a eurite dyke at Surface Hill and a eurite dyke passing into pegmatite five miles to the west. Of the four specimens that were auriferous two were eurites, a third rotten granite, and the fourth an unaltered granite. These assays would not therefore appear to afford any clue as to what description of stone is most likely to carry gold.

* In every case the assay samples were taken by chipping corners off the specimens. In this case the second assay was made on a freshly-chipped sample.

It will be seen from the descriptions that the granite consists essentially of quartz and flesh-coloured felspar; mica and accessory minerals being rare. Triclinic felspar is common [*See* Nos. A 244, 245, 246, 251, 253]. It would thus come under the old term "binary granite," and approximate to the "aplites" and "granitites" of some authors. There does not, however, appear to be any need for a distinctive name. The dyke rocks, consisting of very fine-grained granites, can be classed as eurites.

Questions have been raised locally as to whether the granite may not be of metamorphic origin. There do not appear to be any indications in favour of such a theory. The assays were made in the Departmental Laboratory under the supervision of Mr. J. C. H. Mingaye, F.C.S.

XXVIII.—Petrological Notes on two Andesites associated with Auriferous Deposits in N. S. Wales: by J. B. JAQUET, A.R.S.M., F.G.S., Geological Surveyor.

[Plate XX.]

THE specimens of one of the andesites I obtained from the walls of the Bushman's Hill Mine, which is situated about a mile from Parkes, in a northerly direction. The igneous rock occurs here as a large dyke intruding indurated slates of Silurian age.

The reef exploited by this mine has recently been yielding some very rich ore. During the past three years, while worked on tribute by a party of miners, 2,899 tons of ore containing 8,380 oz. of gold have been raised from it. The vein varies in width from ten inches to two feet. It is composed essentially of quartz with some iron pyrites. The gold which it yields is coarse, and the greater portion of it readily amalgamates in the mortar and on the battery plates.

The walls are smooth and slickensided, and the fissure which preceded the reef has without doubt been formed along a line of faulting; hence we may expect the reef to be permanent and not pinch out when followed downward. When hitherto exposed, the walls are chiefly composed of andesite, but also in places of slate.

The mean of several determinations for the specific gravity of the andesite gave it as 2·82. It breaks with a subconchoidal fracture, and possesses a greyish green colour. The numerous hornblende idiomorphs can be seen with the naked eye, and are easily distinguished by the aid of a hand-glass.

When examined in thin sections under the microscope, the rock is seen to consist of crystals of triclinic felspar and hornblende with grains of magnetite imbedded in a cryptocrystalline ground mass. Minute veins of calcite occur in places. The felspars are much kaolinised, and in many instances have been entirely replaced by a mosaic of quartz granules with some calcite. One of these altered crystals is figured upon the plate accompanying this paper (Pl. XX, Fig. 3.)

The specimens of the other andesite were collected near the Old Copper Mine, about a mile and a half west of Blayney.

The rock occurs as a large boss intruding Silurian slates. A considerable amount of copper has been won from a lode running through it; and in 1892 a rich patch of alluvial gold which, without doubt had been derived from a reef close at hand, was discovered in clay resulting from its decomposition.

Particulars concerning this gold deposit will be found in my report written at the time of the discovery.*

The rock has a specific gravity of 2·88, and possesses a greenish colour. When examined by the naked eye dark augite idiomorphs are seen standing out prominently from a lighter base.

Under the microscope it is found to consist of crystals of triclinic felspar and augite with magnetite grains imbedded in a cryptocrystalline base. The felspar crystals are lath-shaped and much kaolinised. The augite crystals are frequently twinned, and a number of them are more or less altered into chlorite. In other places this mineral has passed into uralite; good examples of this paramorph are to be seen, one of which is figured upon the plate accompanying this paper (Pl. XX, Fig. 1.)

Uralite has been previously noted as being present in some of the andesites found in the southern portion of the Colony by my late Colleague, Mr. W. Anderson.†

The Rev. J. Milne Curran, has described an "augite porphyrite," which he obtained in a cutting near the Roman Catholic Church at Blayney; but the particulars which he gives shows it not to be identical with rock occurring near the Old Copper Mine, and described above.‡

Andesitic rocks would seem not infrequently to accompany the auriferous deposits in New South Wales. I found in looking through the collection of rock-sections belonging to the Geological Survey, a hornblende-andesite from Sofala, an augite-andesite from the Wentworth Proprietary mine at Lucknow, and a pyroxene-andesite from Mitchell's Creek, near Wellington.

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* Ann. Rept. Dept. Mines and Agric. N. S. Wales for 1893 [1894], p. 120.
† Records Geol. Survey N. S. Wales, 1894, II, Pt. 4, p. 141.
‡ Journ. R. Soc. N. S. Wales, 1891, XXV, p. 221.

XXIX.—An undescribed Coral from the Wellington Limestone, N. S. Wales: by R. ETHERIDGE, Junr., Curator of the Australian Museum.

[Plates XXI—XXII.]

A VERY characteristic coral occurs in the Cave Limestone at Wellington, that appears worthy of description. Its appearance alone is exceedingly noteworthy, as the form presents some very instructive examples of calicinal gemmation in single buds. It is very closely allied to *Tryplasma æquabilis*, Lonsdale,* and for it I propose the name of *T. wellingtonensis*.

The corallum in the earlier stages is short turbinate-conical, with a few anchoring rootlets at the extreme base, that did not extend upwards as the coral grew; nor are there any connecting processes with other individuals—the corallum is, therefore, simple, and neither aggregate, nor composite. The immediate base is sometimes slightly expanded as if forming a base of attachment. As the corallum grew it became more cylindrical and less turbinate, often twisted, and, in a few instances, bent upon itself (Pl. XXI, Fig. 2).

Budding took place from the inner rim or margin of the calice, the new corallite either continuing its upward growth from the attenuated base, or, at once rapidly expanding, soon filled the parent calice. In one specimen (Pl. XXI, Fig. 1) the latter continued its growth under the former condition, and ultimately united with the outer surface of its offspring.

The wall is moderately thick, and was probably surrounded by an epitheca. I say probably, because the outer surface of the whole of the specimens has become so entirely converted into beekite, that it is difficult to state with certainty what its precise condition was. The calice seems to have been deep, and fairly straight-walled.

The septa are marginal and lamellar in the first instance, very short, of two orders, alternately large and small, and all terminating on their inner edges in free denticles that project into the visceral cavity, or intertabular spaces, as the case may be (Pl. XXII, Figs. 1 and 4). The greatest number of septa counted in any portion of one calice is thirty, but this number only represents a portion, and there are, in all probability, quite fifty. No opportunity having arisen of examining an absolutely unoccupied, or on the other hand, perfect calice, this

* Murchison's Geology of Russia, 1845, I, t. A, f. 7.

number even is open to emendation. No trace of a fossula has been observed, nor any superiority in size or length, beyond the division into two orders of one septum over another.

The tabulæ are very numerous, thin and delicate, close together, or widely separated, complete or incomplete, horizontal or oblique, either extending wholly across the corallum, or coalescing with one another, and in the latter case enclosing irregular, or subvesicular, intertabular spaces (Pl. XXII, Fig. 1). The tabulæ do not merely reach from septum to septum on the same level, as described by Dybowski in his genus *Acanthodes*, but unite with the walls on opposite sides, and assist in supporting the general structure (Pl. XXI, Fig. 5; Pl. XXII, Fig. 1). They have a rolling surface, and naturally from the form of the septa there is no extension of these structures on them, nor is there the slightest appearance of a columella.

There are no accretion rings in the strict sense of the word, but the apparent presence of these is caused by the edges of old calices, where a younger corallite has grown rapidly within and then completely infilled it (Pl. XXI, Fig. 1). At times a small space is left between the two, in which the tooth-like septa are just visible (Pl. XXI, Fig. 4). In all cases where the calice has not been filled by a younger corallite it will be found in mature examples, to be deep, straight-walled, and the bottom formed by the youngest tabulum, and usually uneven from the rolling nature of the latter.

In a young shallow example that has just expanded, and attained no height (Pl. XXI, Fig. 8), the septa cover nearly the whole surface, some lamellar, the others consisting only of a series of points.

In Pl. XXI, Fig. 6 a very interesting specimen is depicted. The wall has been removed by natural disintegration together with the septa. The latter are now represented by a series of pits in vertical rows, and the interseptal loculi by the intervening ridges. Lonsdale figured an example of his *Tryplasma æquabilis** in a similar condition. As I have previously pointed out,† it was probably this condition that induced Lonsdale to believe that the septa were pierced "from the inner surface of the wall, through the whole breadth, by well defined relatively large foramina".‡ Indeed his figure of *T. æquabilis* is perfectly in accord with our specimen (Pl. XXI, Fig. 6), exhibiting the decorticated or weathered longitudinal section. Furthermore, in Lonsdale's figure, the tabulæ are continued from wall to wall. The structure of this specimen entirely bears out the explanation I have previously suggested of this phenomenon.

* Murchison's Geology of Russia, 1845, I, p. 613, t. A, f. 7.
† Records Geol. Survey N.S. Wales, 1890, II, Pt. 1, p. 17.
‡ Lonsdale, *loc. cit.*, p. 613.

I have not seen the slightest trace of any epithecal scales, rhombic or otherwise. On account of the silicification of these corals, and the conversion of the entire outer surface into beekite, it is even difficult to distinguish the presence of costæ. I have, however, seen a trace of them in one specimen. The surface of the Wellington corals is covered by prickles, but these are the central points of the beekite rosettes, and not in the slightest degree epithecal structures. I have already figured* similar rosettes, with an elevated central point, in other corals from Wellington, and the prickle-like elevations partake of the same nature.

In a coral with such remarkably short and distally free septa dissepiments would not be expected, but at times a single dark plate is developed. In the horizontal section (Pl. XXII, Fig. 5) of a portion of the wall, prepared for the microscope, this ring is displayed. It is, in all probability, not formed by a series of dissepiments in a single line, but is the primitive theca in the substance of the outer investment, and septa traversing this zone have an intra- and extra-thecal portion. In a rather more complete section (Pl. XXII, Fig. 2) an inner ring is visible which might be taken for a further series of dissepiments,—it is however, a second corallite springing from within the older one. This is at once apparent from the fact that the septa of the older and outer calice are seen to pass over this wall and be above those of the inner and lower calice.

The septa are thorn-like thickened bodies, quite homogenous (Pl. XXII, Fig. 4), and without any trace of primordial septa. In the vertical section (Pl. XXII, Fig. 1) the septa appear to be composed of concentric layers of stereoplasma. On the upper left-hand portion of this section are several septa, transversely cut, projecting inwards from another portion of the wall. On the lower left-hand side are the free ends of septa extending from the wall into the intertabular spaces (Pl. XXII, Fig. 4).

The vertical section also shows that the tabulæ unite with the wall, and are thickened. Their irregularity and frequent incompleteness is also shown, often coalescing with one another and enclosing spaces that almost give rise to a vesicular appearance.

The specimens were collected at Wellington by Mr. W. Anderson, late of the Geological Survey of New South Wales, Mr. P. T. Hammond, Field-Assistant, and Mr. J. Sibbald, Keeper of the Wellington Caves. The specimen from the Jenolan Caves was obtained by Mr. J. C. Wiburd, Guide.

* Rec. Austr. Mus., 1893, II, No. 5, p. 76, t. 16, f. 4.

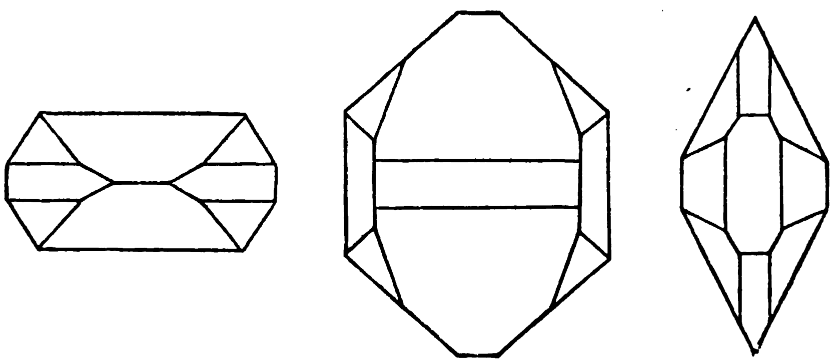
XXX.—On a Supposed Sulpho-carbonate of Lead, from the Australian Broken Hill Consols Mine, Broken Hill: by P. T. HAMMOND, Field Assistant.

THE specimen which forms the subject of this paper was presented to the Government Geologist by Mr. G. Smith, the General Manager of the Consols Mine.

It is of irregular outline, measures eleven and a half inches by eight inches across, and consists of a mass of crystals ranging from about an eighth of an inch or less to half an inch in length, seated on cerussite, which is for the most part in fine acicular crystals, though in parts massive. The specimen has also a few arrow-head-shaped twins of the same mineral on its surface, and is more or less intimately mixed with it throughout the whole mass, rendering it an exceedingly difficult matter to obtain a pure sample for assay, the two minerals being similar in colour and nearly alike also in lustre. A few specks of galena also occur throughout the mass, and the side which has been attached in the lode is partly coated with the same mineral.

Crystallographic System.—Rhombic, some crystals having the appearance of being monoclinic, owing probably to twinning or to the unequal development of opposite pairs of faces. The crystals examined exhibited faces of the right rhombic prism ∞P, variously modified by faces of the right rhombic pyramid m P, the macropinakoid $\infty \bar{P} \infty$, the brachypinakoid $\infty \breve{P} \infty$, macrodome m $\bar{P} \infty$, and brachydome m $\breve{P} \infty$.

Faces of a second rhombic prism of different angle are also observable in some crystals.



(The above figures are sketched, measurements of the angles not having been obtained.)

Physical Characteristics.—Cleavages imperfect. Colour from white to colourless, transparent to translucent. Lustre vitreous on the faces of the crystals, adamantine to resinous on fractured surfaces. Striations on faces very exceptional. Brittle and with an irregular fracture. Hardness = 3. Streak, white. Specific gravity= 6·22—6·33.

Composition.—Two analyses were made (the first in duplicate) by Mr. J. C. H. Mingaye, F.C.S., of samples picked with great care, with the following results:—

Analysis No. 1.

	1	2
H_2O	nil.	nil.
PbO	74·11	74·09
SO_3	22·27	22·23
CO_2	3·32	3·36
	99·70	99·68

The second sample was picked for analysis with a view of determining whether the percentage of CO_2 remained sufficiently constant to warrant either the formation of a new species, or the classification of the mineral as a variety of a previously established sulpho-carbonate, as an examination with the blowpipe and commoner reagents had already indicated the presence of SO_3 and CO_2.

Analysis No. 2.

PbO	74·11
SO_3	25·00
CO_2	1·34
	100·45

It will be seen from an examination of these analyses that there is not only considerable variation in the percentage of CO_2 in the mineral, but also that the percentage is not high in either of them.

Reaction before the Blowpipe, &c.—Fuses easily in a candle flame with a little decrepitation to a clear globule which becomes opaque on cooling, or in part turns, at first yellow, then orange red or brownish yellow, becoming again yellow on cooling. If the heat be increased it fuses to a metallic bead of lead. On charcoal yields a metallic bead with a yellow incrustation, which turns white on cooling. Fused with carbonate of soda on charcoal, and placed with water on a silver coin, blackens the silver. Effervesces in warm hydrochloric acid.

Difference from hitherto described Sulpho-carbonates.—Dana classifies all the known sulpho-carbonates of lead under one species, Leadhillite, which is described as monoclinic in his "System of Mineralogy," 1892, although described as "orthorhombic," though "monoclinic in aspect" in the earlier editions of the

same work, which he attributes to hemihedrism in some of its planes. It is also described as having one perfect cleavage, and the laminæ are said to be flexible. The mineral under examination is, I think, undoubtedly rhombic as shown in the figures, although a number of the crystals have undergone very unequal development, thus causing them to assume occasionally a monoclinic aspect. It does not show any perfect cleavages, and, far from being flexible, is extremely brittle. It differs also from leadhillite in the very low percentage of carbon dioxide, containing only 3·36 per cent. as against 7·98 to 12·12, which is the range of the various analyses given by Dana, and in the second analysis made it is even lower, being only 1·34.

It differs also in its superior hardness, leadhillite being 2·5, whereas the Broken Hill mineral is 3; another difference, as pointed out by the Government Geologist, is the anhydrous condition of the latter, as leadhillite contains from 1·5 to 2·70 of water.

Of Lanarkite, which was formerly described as a sulpho-carbonate by Brooke,* Bauerman says:—† "This was formerly regarded as containing equal molecules of sulphate and carbonate of lead; but late researches by Flight and Pisani have explained away the carbonate, and make it consist of Pb. SO_4 Pb. O, or Pb. SO_4, 57·6, Pb. O, 42·4," and Dana‡ gives five analyses by Flight, Pisani, and Collie, none of which show the presence of CO_2; nevertheless, as our mineral contains so low a percentage of CO_2, as barely, if at all, to remove it from the sulphates, a comparison with this species may not perhaps be considered superfluous. Lanarkite differs from it in being monoclinic in form, in having one perfect cleavage, in being flexible in thin laminæ, and in its inferior hardness,=2 to 2·5, which is about equal to that of leadhillite.

Susannite is classed by Dana as a variety of leadhillite, and does not differ materially from that species in its physical or chemical properties.

Caledonite, a cupreous sulpho-carbonate of lead, needs only passing mention here, as the Broken Hill mineral has not been found to contain copper.

Affinities.—Both in its crystallographic form, and in its physical properties, and behaviour before the blow-pipe, the mineral under examination agrees closely with anglesite (sulphate of lead), and appears to differ from that mineral only in the presence of, at most 3·3 per cent. of carbon dioxide.

The crystalline form of some of the crystals agrees very closely with a figure given by Bauerman§ for anglesite, where he also remarks, "The crystalline forms of anglesite are of especial interest as showing the amount of variation of

* Brooke, Edin. Phil. Journ., 1820, III, p. 117 (*fide* Dana.)
† Descriptive Mineralogy, 1884, p. 303.
‡ Dana, System of Mineralogy, 1892, p. 923.
§ Descriptive Mineralogy, 1894, pp. 289, 291.

character possible in substances of rhombic symmetry," and, further, that it has been observed in "thirty-one forms and one hundred and seventy-eight combinations," so that it is not surprising if the crystals examined do not exactly conform to previously figured ones.

Anglesite has been recorded for New South Wales by Prof. A. Liversidge, M.A., F.R.S.,* as occurring at the Abercrombie River, at Silverton, at South Wiseman's Creek, and at Severn River, and by Mr. J. B. Jaquet, A.R.S.M, &c.,† in small quantities on the upper portion of the Thackaringa Lode.

Conclusions.—As the percentage of CO_2 is so low in this mineral, and taking into consideration the close resemblance in crystallographic form and physical properties to anglesite, I would suggest either that it is a variety of that mineral, or as seems to me the more probable solution, that the CO_2 is to be accounted for by the penetration of small crystals of cerussite into the crystals of anglesite, as, owing to the similarity of the one to the other; and their intimate admixture, they would be very easily overlooked, though the sample might be chosen with the greatest care. Another possible solution is that the mineral may be in the transition stage from anglesite to cerussite, for, as Rutley says,‡ cerussite "may result directly from the decomposition of anglesite by water charged with bicarbonates."

I would, therefore, submit that that the mineral is not a new species, but that it is a specimen of anglesite intimately associated with cerussite, this intimate association would sufficiently account for its somewhat anomalous behaviour before the blowpipe.

Another specimen from Block 10 Mine, Broken Hill, measures five inches each way, and consists of a mass of small crystals of anglesite, (none of which exceed, and few attain to a quarter of an inch in length) grouped in branching forms on cerussite, which is in part massive, and in part consists of fine acicular crystals. This, in turn, rests on a spongy semi-crystalline mass of galena, which exhibits plain evidences of decomposition, and subsequent removal of much of its substance; this, as in the former case, is the side of attachment.

The crystals are of a greyish tinge, are very irregularly developed, and for the most part conform to the description given for the specimen from the Consols Mine; but although no striations are visible on the crystals, the faces in $\breve{P}\infty$ have in all cases a frosted or roughened appearance, which is not seen in the previously described specimen.

In physical properties and reactions with the blowpipe, &c., the two specimens are identical.

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* Minerals of N. S. Wales, 1888, p. 64.
† Geology of the Broken Hill Lode (4to. Sydney, 1894, by Authority), p. 113.
‡ Rutley, Elements of Mineralogy, 1887, p. 104.

XXXI.—On additional Aboriginal Rock-carvings on the French's Forest Road, near Bantry Bay: by W. S. DUN, Assistant Palæontologist.

[Plates XXIII and XXIV.]

IN 1890, Mr. R. Etheridge, Junr., described* a set of Aboriginal Carvings occurring on a surface of the Hawkesbury Sandstone at the side of the French's Forest Road, Parish of Manly Cove, County of Cumberland. This locality is on Reserve 41, about three and a half miles from the Spit. The exact position of the carvings is shown on Plate XXIII. It is not my intention to discuss the relations and affinities of the designs, as these have already been so successfully performed by the above-mentioned Writer, but merely to record the uncovering of some additional delineations and figure them for future reference and comparison.

Towards the end of last year the scrub and a thin coating of soil were cleared off portions of this table of rock, under the supervision of Mr. W. S. Leigh, Superintendent of Caves, and by these means the additional outlines were brought to light. As was the case in the formerly described ones, these are very faintly marked and difficult to trace.

II.—Description of Figures.

Three figures in their relative positions are shown on Pl. XXIV, Figs. 1, 4, and 5. To the best of my knowledge, no outlines similar to these have been recorded from New South Wales. Fig. 4 appears to show a slight constriction at the upper end, which gives a roughly head-like form to this portion. These two figures may bear some relation to two outlines occurring at Flat Rock, near Manly, and figured, without any remarks by Mr. Etheridge as being within the outline of a large fish.† In juxtaposition to what may be termed the right limb of Fig. 4 is an outline with a rounded head, which becomes constricted, and then continued in a short, wide prolongation. If the proportional length of this portion were only exaggerated, this might be taken to represent some form of club.

Three unmistakable delineations of tomahawks are shown by Figs. 3, 10, and 12. Fig. 3 represents a form in which the head is slightly curved upwards, and the handle is attached to the middle of the head. In Fig. 4 is represented a common form of Aboriginal tomahawk, oblong-ovate in shape and more sharply curved at the cutting edge; in this case the handle is attached to the end. In Fig. 10 is shown an elongate oval and slighted pointed weapon with the handle attached to the middle of the blade.

* Records Geol. Survey N. S. Wales, 1890, II, Pt. 1, pp. 26–35, t. 2.
† Records Geol. Survey N. S. Wales, 1892, II., Pt. 4, t. 16, f. 1.

In Fig. 2 we have the representation of a fish showing the caudal fins only; this is a little over a foot in length. The caudal fins are much more perfectly represented than in the drawing figured in Mr. Etheridge's paper.

An outline of what I think must be taken to represent a foot is shown in Fig. 6. This is one foot eight inches in length and eight inches across at its broadest part; five toes are depicted.

In Fig. 7 we have a long narrow object, three feet eight inches in length and seven inches wide, of doubtful affinity; and in Fig. 8 is a circular outline.

The subject of Fig. 11 is somewhat similar to Fig. 7; it is six feet there inches in length, eleven inches wide, and there is a slight constriction at one end.* This may represent an elongated fish, possibly an eel.

By far the best outline of this new set of carvings is shown in Fig. 9. This is the undoubted representation of a kangaroo, three feet ten inches from the nose to the tip of the tail and one foot six inches high at the shoulder. The ear and a fore and hind limb are shown. The tail has the characteristic thickening at the base very strongly developed. No eyes are shown as in the other drawings of kangaroos at this locality.

A plan is appended to this note, showing the relative position of the site of these interesting carvings to Manly and North Sydney.

XXXII.—The Australian Geological Record for the Year 1894, with Addenda for 1891 to 1893; by R. ETHERIDGE, Junr., Curator of the Australian Museum, and W. S. DUN, Assistant Palæontologist.

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* *Loc. cit.*, t. 2, f. 5, 14.

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PLATE XVII.

Phyllotheca? *sp.*

Fig. 1. Branch, with the remains of six peltate organs.

Fig. 2. Another branch, with portions of four organs, and traces of transverse striation.

Fig. 3. Branch, with a small peltate organ, seen somewhat from below.

Fig. 4. Another example, somewhat larger than Fig. 3.

Fig. 5. Branch, with one organ at the base, and signs of attachment of three others above.

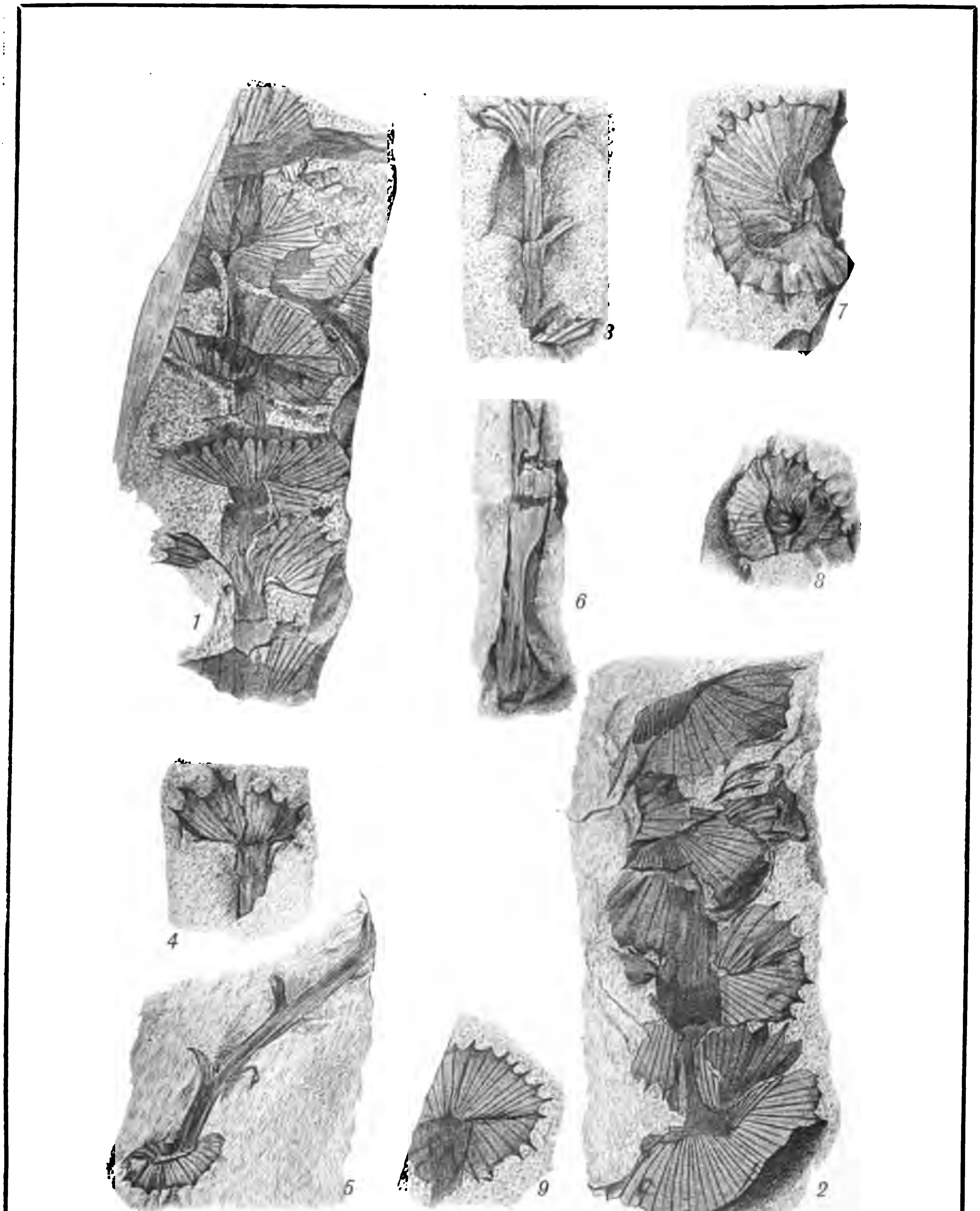
Fig. 6. Denuded branch.

Fig. 7. An organ of large size, compressed from above, showing the spike-like extensions at the periphery, the nerves (?) proceeding to them and the re-entering spaces.

Fig. 8. A smaller organ, compressed from above.

Fig. 9. An organ attached to the branch, the upper half almost in its normal condition, the lower half bent backwards and downwards.

Drawn from nature by Mr. P. T. Hammond.



P. T. Hammond, del.

Heliotype.

PLATE XVIII.

Phyllotheca, *sp.?*

Fig. 1. A stem, exhibiting seven nodes, and indistinct striation.

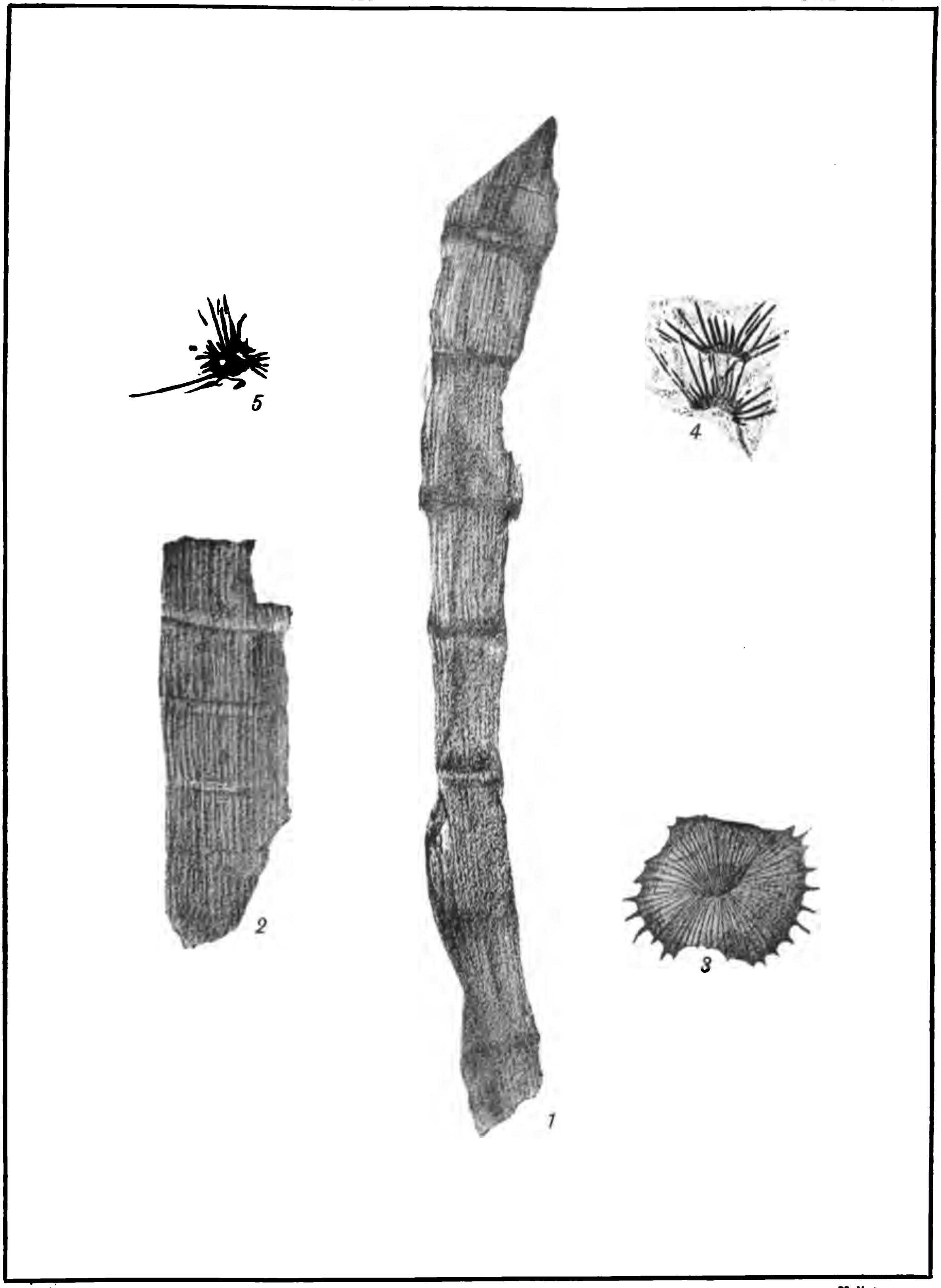
Fig. 2. A broader stem, with five nodes, and the costæ more marked. The internodes are relatively shorter and broader in this example.

Fig. 3. A peltate organ, seen from above, showing the central invagination and spine or tooth-like terminations of the radiating ribs.

Fig. 4. Foliage, around two nodes, the stem being faintly indicated between.

Fig. 5. Foliage, around a node, seen from above.

Drawn from nature by Mr. P. T. Hammond.



P. T. Hammond del. Heliotype.

PLATE XIX.

Plan and sketch section, showing the position of the shale bed at Newcastle, from which the *Phyllotheca?* remains were collected by Mr. J. B. Henson, C.E.

Scale—2 chains to 1 inch.

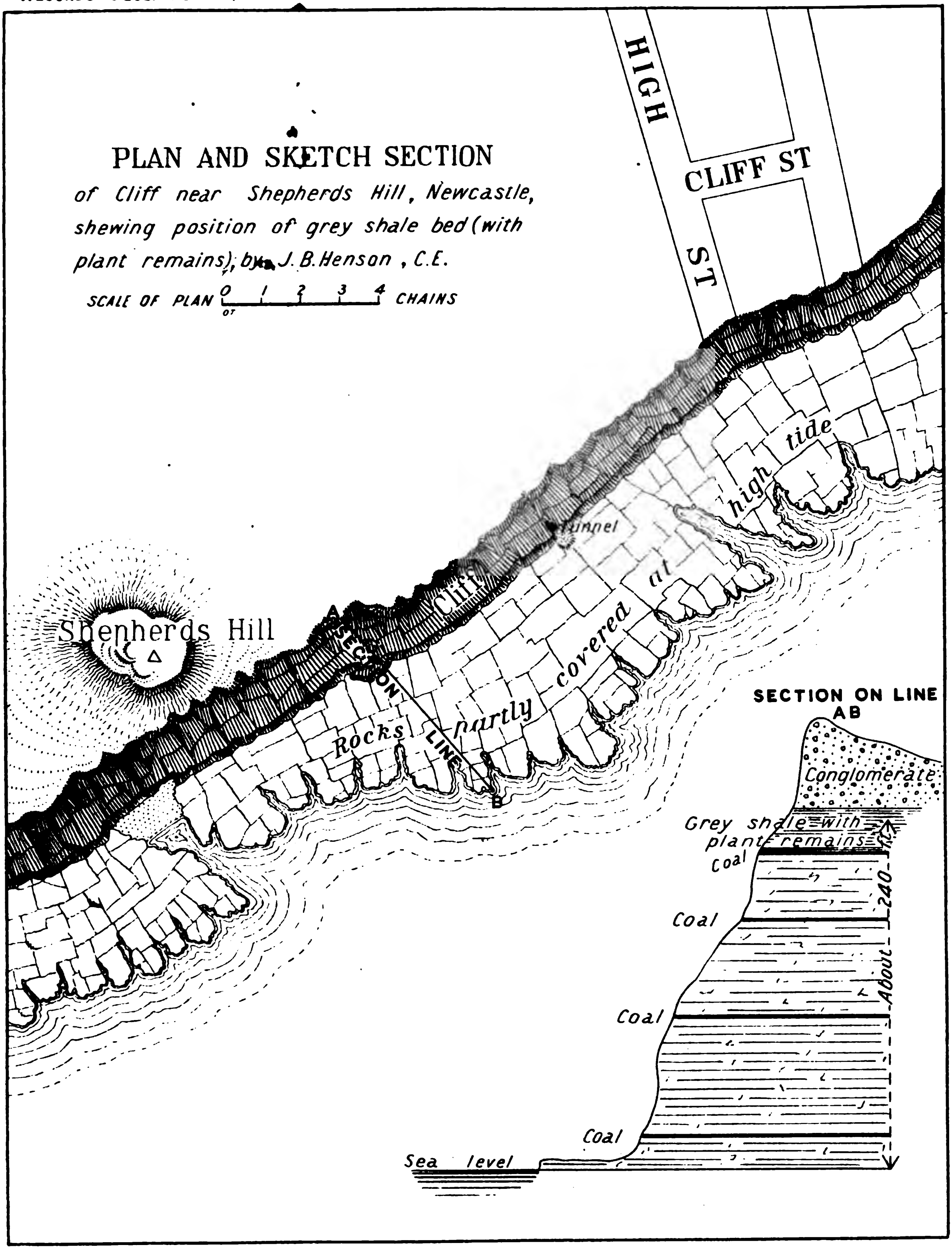


PHOTO-LITHOGRAPHED AT THE GOVT. PRINTING OFFICE, SYDNEY, NEW SOUTH WALES.

PLATE XX.

Fig. 1. Crystal of Uralite (augite passing into hornblende), occurring in augite andesite, from Blayney.

Ordinary light; magnified 35 diameters.

Fig. 2. Hornblende-andesite, from Bushman's Hill Mine, near Parkes.

Minerals represented are hornblende, triclinic felspar, and magnetite.

Ordinary light; magnified 40 diameters.

Fig. 3. Portion of a Felspar crystal, replaced by a mozaic of quartz granules and calcite, from same slide as Fig. 2.

Drawn from nature by Mr. P. T. Hammond.

1

2

3

P. T. Hammond, del. Heliotype.

PLATE XXI.

Tryplasma wellingtonensis, ***Eth. fil.***

Fig. 1. Parent corallum, with a matured bud, the interspace between parent and offspring having been subsequently filled-in by the former. Wellington.

Fig. 2. A much curved corallite. Wellington.

Fig. 3. A more or less straight corallite, showing costæ. Wellington.

Fig. 4. A parent corallite and two buds, the first of the latter almost entirely infilling the original calice. Wellington.

Fig. 5. Natural section of a corallite, exhibiting moderately regular tabulæ, rather more distant from one another than is usually the case, and along the fractured edges the spine-like septa. Jenolan Caves.

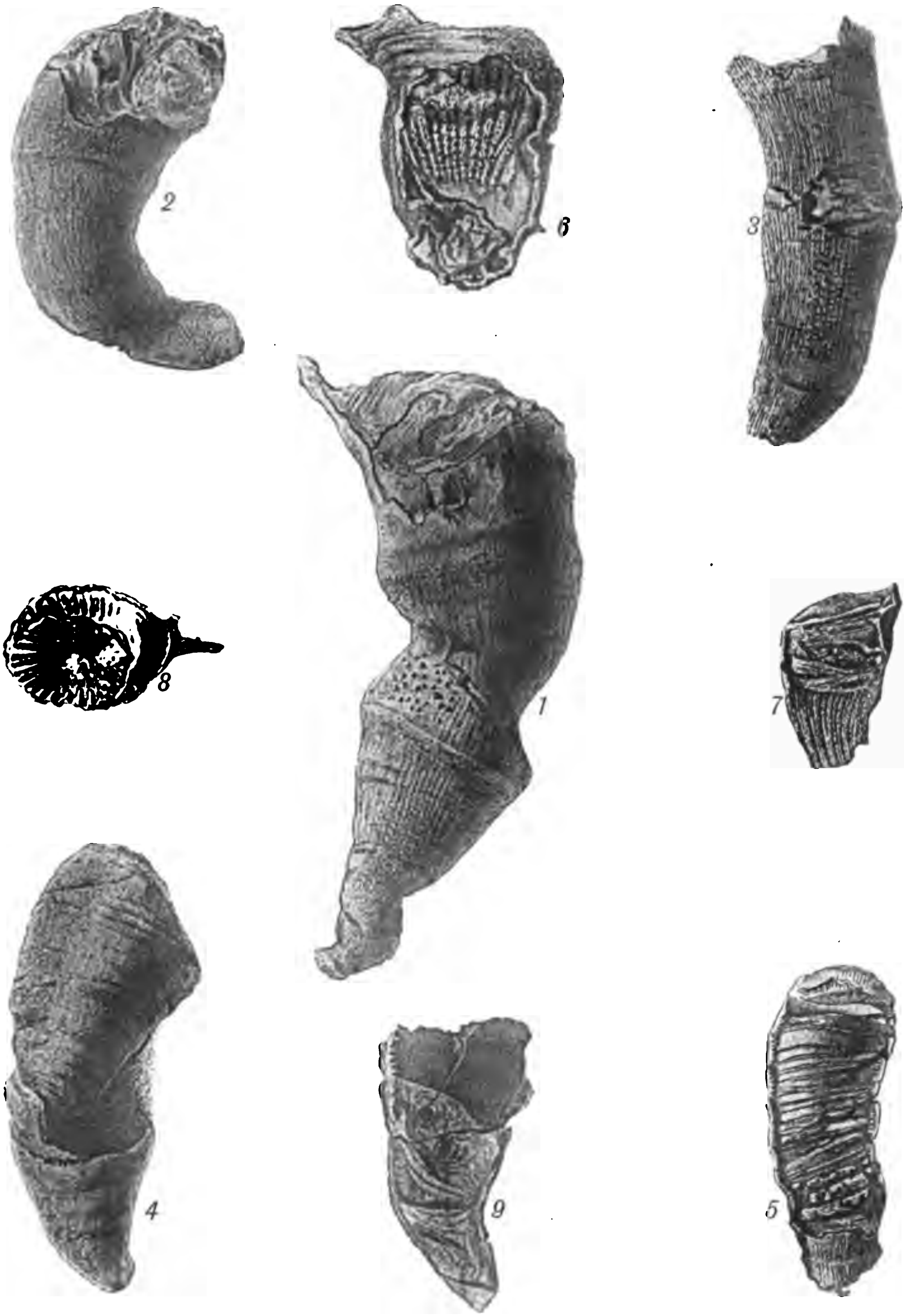
Fig. 6. Natural section, highly weathered, with the wall and septa removed, showing the latter represented by small pits, and the inter-septal loculi as ridges. Wellington.

Fig. 7. A somewhat similar specimen to Fig. 6, the lower portion showing like characters, and the upper crushed tabulæ. Wellington.

Fig. 8. Two shallow calices, one within the other, both exhibiting the spine-like septa. The older or outer corallite also displays anchoring rootlets protruding from near the base. Wellington.

Fig. 9. A polished section of a corallite, with irregular tabulæ in the lower part and spine-like septa protruding into the calice in the upper. Wellington.

Drawn from nature by Mr. P. T. Hammond.



P. T. Hammond, del. Heliotype.

PLATE XXII.

Tryplasma wellingtonensis, *Eth. fil.*

Fig. 1. Longitudinal section, prepared for the microscope, displaying the irregular and incomplete tabulæ. At the right-hand upper, and left-hand lower corners are the septa protruding into the inter-tabular spaces; and at the upper left-hand corner are the cut apices of septa projecting from the opposite wall. Wellington. ×2.

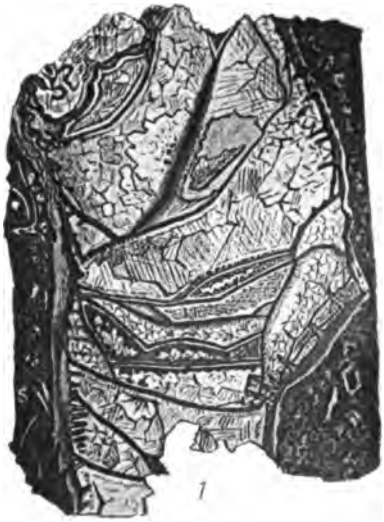
Fig. 2. Transverse section of another specimen, similarly prepared, displaying the septa of an older corallite projecting over the wall of a bud arising from below. Wellington. ×2.

Fig. 3. The upper left-hand corner of Fig. 1. ×3.

Fig. 4. The lower left-hand corner of Fig. 1. ×3.

Fig. 5. A portion of the septal edge of Fig. 2. ×3.

Drawn from nature by Mr. P. T. Hammond.



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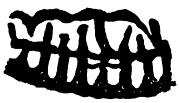
3



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4

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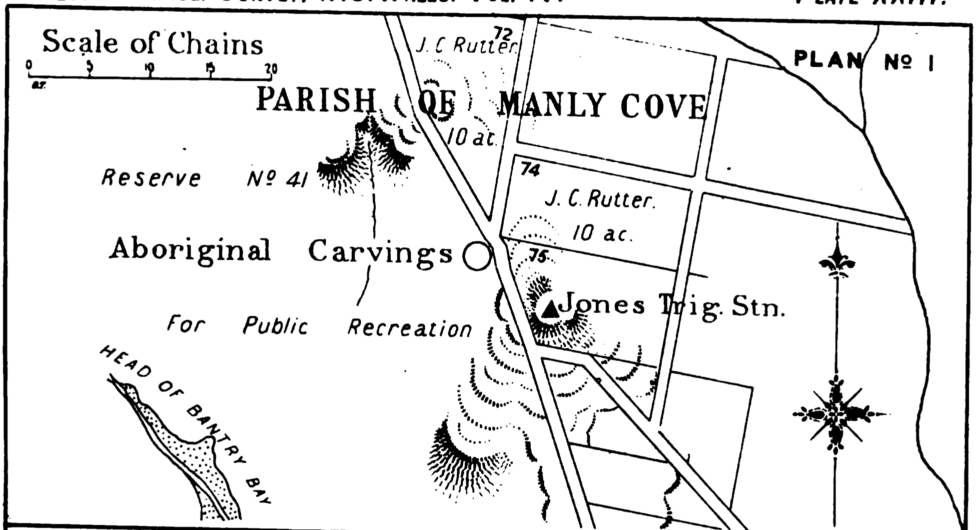
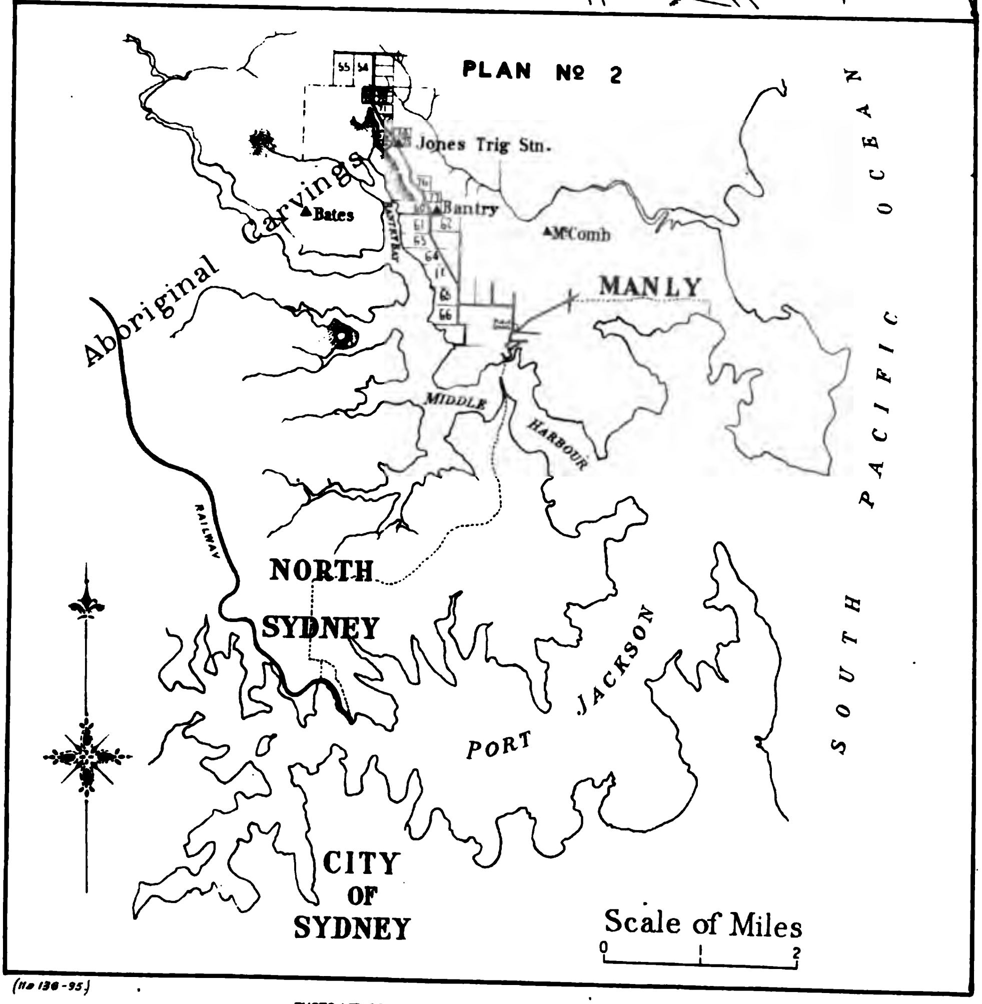
P. T. Hammond, del. Heliotype.

PLATE XXIII.

Sketch Plan, showing position of Aboriginal Rock Carvings, Parish of Manly Cove, County of Cumberland.

Scale—Plan No. 1, 10 chains to 1 inch.
Plan No. 2, 1 mile to 1 inch.





(No 136-95)

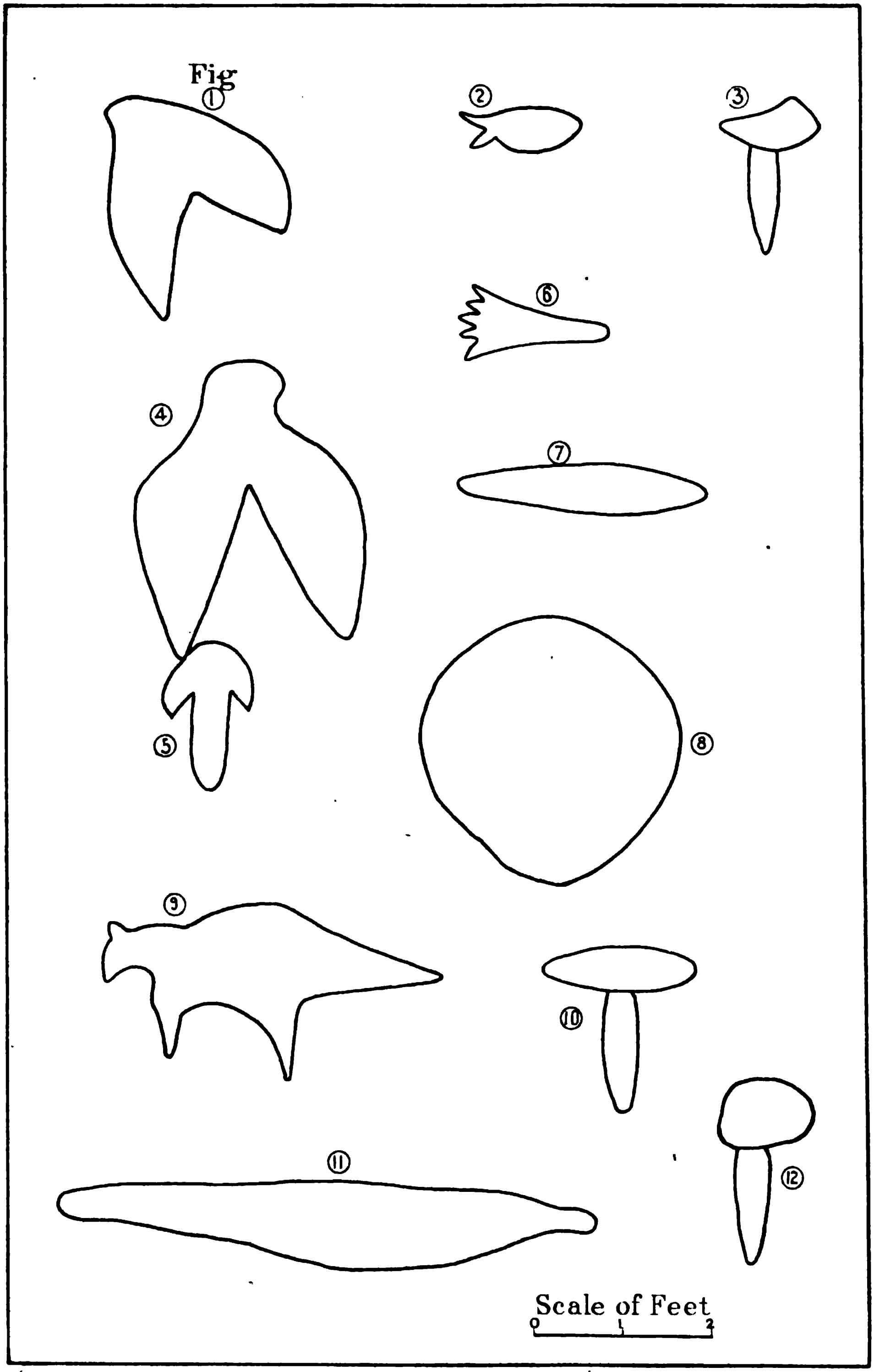
PHOTO-LITHOGRAPHED AT THE GOVT. PRINTING OFFICE, SYDNEY, NEW SOUTH WALES.

PLATE XXIV.

Aboriginal Rock Carvings at the head of Bantry Bay, Parish of Manly Cove, County of Cumberland.

Drawn by Mr. O. Trickett, from sketches and measurements.

Scale—1 inch to 1 foot.



(No 136-95)

PHOTO-LITHOGRAPHED AT THE GOVT. PRINTING OFFICE.
SYDNEY. NEW SOUTH WALES.

CATALOGUE OF MINING MAPS

PUBLISHED BY THE

DEPARTMENT OF MINES AND AGRICULTURE, SYDNEY, NEW SOUTH WALES,

APRIL, 1894.

To be obtained at the Department of Mines and Agriculture, Sydney, and at the Warden's Office in the Mining District in which the land represented on the map or plan is situated.

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MINING DISTRICTS.

Parish, or part of.	Mining District.	Gold-field.
[b]ercrombie (part of)	Tumut and Adelong	Umaralla.
[A]delong (part of)	do do	Adelong Creek.
...ala do	Peel and Uralla	Swamp Oak and Niangala.
...irly	Mudgee	
[A]lbert	Albert	Albert.
...lbeila	do	do
[A]lbury	Tumut and Adelong	Black Range (partly).
...lma	Albert	Albert.
Do (town of)	do	do
[A]nderson	Peel and Uralla	Tingha.
...nandale	New England	Emmaville (partly)
...son (part of)	Bathurst	
...ntimony	New England	Boorook and Lunatic.
...kell (part of)	Bathurst	Caloola Creek (partly).
...rvid	New England	Emmaville (partly).
...ston	Peel and Uralla	Tingha.
...ealba	Hunter and Macleay	
...adjerrigarn	Albert	Albert.
...gawa	Clarence and Richmond	Orara.
...ald Nob	Peel and Uralla	
...allalala (part of)	Tumut and Adelong	Molonglo (partly).
...allandean	New England	
...allina	Clarence and Richmond	Tweed and Richmond Rivers (partly).
...andamora	Tambaroora, and Turon, and Mudgee.	Turon River (partly).
...anghurst	Peel and Uralla	Bingara (partly).
Do (part of)	do do	do do
...aring	Bathurst	Oberon.
...arney Downs	New England	Boorook and Lunatic.
...arrangee (part of)	Albert	Albert.
...ice (part of)	New England	Emmaville.
...eeree	Bathurst	Beneree (partly).
...ermagues	Southern	Dromedary.
...errima	do	
...erwarra	do	
...elera	Hunter and Macleay	Barrington and Gloucester.
...ngara	Peel and Uralla	Bingara.
Do (part of)	do do	do
...nghi	New England	Emmaville.
...ackheath	Bathurst	
...air	New England	Emmaville.
...igh	Albert	Albert.
...oxsome	Peel and Uralla	
...lubdura (part of)	Tambaroora and Turon	Macquarie River, Stony Creek, and Ironbarks
...olga (part of)	do do	Wellington.
...aira	Albert	Albert.
...ombah	Bathurst	Mulgunnia and Abercrombie.
...angadah	Albert	Albert.
Bookookara (pt. of)	New England	Boorook and Lunatic.
Do do	do do	do do
Booloombayt	Hunter and Macleay	Gloucester.
Boona	Cobar	Bogan.
Do East	do	do
Do West	do	do
Boonoo Boonoo (pt. of)	New England	Boorook and Lunatic.
Boorook	do do	do do
Boranel	Hunter and Macleay	Gloucester.
Bowman	New England	Emmaville.
Boyd	Peel and Uralla	
Brangalgan	Tumut and Adelong	Bourke, Cooper, Dowling, and Gipps.
Branxton	Hunter and Macleay	
Bray	Albert	Albert.
Bringellet (part of)	Bathurst	Caloola Creek.
Broadmeadows	Clarence and Richmond	Boyd or Little River.
Broulee (& Tomago)	Southern	Moga (partly).
Brundah	Lachlan	Tyagong Creek.
Buangla (part of)	Southern	Yalwal.
Bulliongong do	Tumut and Adelong	Molonglo (partly).
Bumbaldry	Lachlan	Tyagong Creek.
Bundar	New England	Emmaville (partly).
Bundawarrah	Lachlan	Temora (partly).
Do (part of)	do	do do
Burke	Southern	
Burra	Cobar	Bogan.
Burrandong	Tambaroora and Turon.	Macquarie River, Stony Creek, Ironbarks, and Wellington.
Do (part of)	do do	Macquarie River, Stony Creek, and Ironbarks.
Burrill	Lachlan	Bogan.
Byjerkerno	Albert	Albert.
Byng	Bathurst	Byng (partly).
Byngrano	Albert	Albert.
Cadgee	Southern	Gulph (partly).
Calafat	Tumut and Adelong	Adelong Creek.
Callanyn (part of)	New England	Boorook and Lunatic.
Caloola (part of)	Albert	Albert.
Canowindra	Bathurst	Canowindra (partly).
Carroll (part of)	Tambaroora and Turon	Wellington.
Cargo	Lachlan	Cargo and Canowindra.
Do (part of)	do	Cargo.
Castleton	Bathurst	Turon River and Kirkconnell
Cataract (part of)	New England	Boorook and Lunatic (partly).
Cathcart	Albert	Albert.
Cavendish	New England	Timbarra and Boorook and Lunatic.
Cessnock	Hunter and Macleay	

Parish, or part of.	Mining District.	Gold-field.
Chalmers (part of)	Peel and Uralla	Upper Hunter (partly).
Churchill do	New England	Solferino.
Clare	Peel and Uralla	Tingha.
Clarence (part of)	New England	Tooloom Creek.
Clifford do	Tumut and Adelong	Umaralla.
Clinton	Bathurst	Ophir.
Clive	Peel and Uralla	Tingha.
Coally (part of)	Albert	Albert.
Cobar	Cobar	Bogan.
Cole (part of)	Bathurst	Newbridge (partly).
Collett	Lachlan	Canowindra.
Cologon	New England	Boorook and Lunatic.
Conlarol	Clarence and Richmond	Orara.
Cooba	Bathurst	
Coolamin	Tambaroora and Turon	Macquarie River, Stony Creek, and Ironbarks.
Coolamigal	Bathurst	Turon River.
Coonbaralba	Albert	Albert.
Cooney	Peel and Uralla	Gyra River.
Do (part of)	do do	do
Coorumbung	Hunter and Macleay	
Cope's Creek	Peel and Uralla	Tingha.
Corella	Cobar	Bogan.
Cordeaux	Southern	
Corona	Albert	Albert.
Curry (part of)	New England	Boorook and Lunatic.
Coventry	Peel and Uralla	Kookarabooka.
Cox	Bathurst	
Cranbrook (part of)	New England	Emmaville.
Craven	Hunter and Macleay	Gloucester.
Cullen Bullen	Bathurst	Turon River (partly).
Cullendore	New England	
Cummings (part of)	Tambaroora and Turon	Wellington.
Curragurra do	do do	Macquarie River, Stony Creek and Ironbarks.
Currajong do	Lachlan	Billabong.
Curranbene	Southern	Cooloongatta (partly).
Curreeki	Hunter and Macleay	Gloucester.
Dalmorton (part of)	Clarence and Richmond	Boyd or Little River.
Danjerra do	Southern	Yalwal.
Darby	Peel and Uralla	Tingha.
Derra Derra	do do	Bingara (partly).
Do (part of)	do do	do do
Dering	Albert	Albert.
Dhoon	do	do
Digby	Peel and Uralla	
Dinoga	do do	Bingara.
Do (part of)	do do	do
Dumaresq	New England	Emmaville.
Dungowan	Peel and Uralla	Peel River.
Dunleary (part of)	Bathurst	Milburn Creek.
Edgar	Albert	Albert.
Ellerslie	Cobar	Bogan.
Elsmore	Peel and Uralla	Tingha (partly).
Enmore	Albert	Albert.
Do	Peel and Uralla	Gyra River Extension.
Eskdale	Bathurst	Clear Creek and Kirkconnell (partly).
Ettrema	Southern	Yalwal.
Ensalea (part of)	Tumut and Adelong	Adelong Creek (partly).
Enmur	Peel and Uralla	Ironbarks and Tea-tree.
Eusdale	Bathurst	Kirkconnell and Mount Lambie (partly).
Fairy Hill	Albert	Albert.
Falnash	Bathurst	Turon River (partly).
Fitzroy	Cobar	Bogan.
Flagstone	New England	Emmaville.
Forbes	Lachlan	Billabong and Lachlan, Wellington, Macquarie River.
Do (part of)	Bathurst	Stony Creek, Ironbarks, and Ophir.
Fowler's Gap do	Albert	Albert.
Fremantle do	Bathurst	Ophir (partly).
Fraser	New England	Emmaville.
Do	do	
Gadara (part of)	Tumut and Adelong	Adelong Creek (partly).
Gairdner's Creek	Albert	Albert.
Galbraith	Bathurst	Newbridge and Caloola Creek (partly).
Do (part of)	do	Newbridge (partly).
Gibraltar do	New England	

Parish, or part of.	Mining District.	Gold-field.
Giles (part of)	Albert	Albert.
Gilgurry do	New England	Boorook and Lunatic.
Giffenbine	Cobar	Bogan.
Gillindich	Bathurst	Junction Point, Tu[illegible] and Markdale.
Glenken	Tumut and Adelong	[illegible] Creek.
Gnoupa	Southern	Pambula.
Gooloongolok	Hunter and Macleay	Gloucester.
Gordon	Peel and Uralla	
Gouron (part of)	do do	Bingara.
Graeme	Hunter and Macleay	Nowendoc and [illegible]
Gulgong	Mudgee	Gulgong.
Gulph (part of)	Southern	Gulph (partly).
Guntawang	Mudgee	Gulgong.
Hall	Peel and Uralla	Kookarabooka.
Do	do	Ironbark and Tea-tree.
Do	do	Bingara (partly).
Do (part of)	do	do
Hamilton	New England	Emmaville (partly).
Hampton	Bathurst	Bellubula do
Hanning	Peel and Uralla	
Hargraves	Mudgee	Windeyer.
Hartley	Bathurst	
Haystack	New England	Emmaville.
Heathcote	Southern	
Herbert	Peel and Uralla	Tingha.
Harborn	Hunter and Macleay	Orara.
Highland Home	New England	Emmaville.
Hughes	Albert	Albert.
Ironbarks (part of)	Tambaroora and Turon	Macquarie River, [illegible] Ironbarks, and M[illegible]
Inverary	Southern	Nerrimunga.
Inverell	Peel and Uralla	
Jamberoo	Southern	
Jamieson	Bathurst	
Jellore	Southern	
Jerricknorra	do	Shoalhaven and [illegible] River (partly).
Jingellic East	Tumut and Adelong	[illegible] Creek.
Joadja	Southern	
Jocelyn	Bathurst	Oberon.
Kahibah	Hunter and Macleay	
Kangaloon	Southern	
Kelumbla	Bathurst	
Kerobla	Southern	
Kirk	Albert	Albert.
Lake Macquarie	Hunter and Macleay	
Land's End	New England	Emmaville.
Langdale (part of)	Bathurst	Oberon (partly).
Lennox	do	Ophir do
Lewis	Albert	Albert.
Do (part of)	Bathurst	Ophir (partly).
Lidsdale	do	Mount Lambie (partly).
Loftus (part of)	Peel and Uralla	Swamp Oak and [illegible] (partly).
Macintyre (part of)	do do	Bingara (partly).
Malmaratta	Albert	Albert.
Mandamah (part of)	Lachlan	Barmedman (partly).
Mandolong	Hunter and Macleay	
Manildra	Lachlan	Dilga.
Marangaroo	Bathurst	
March (part of)	do	Ophir.
Marsh	New England	
Martin	Lachlan	Billabong.
Marulan	Southern	Argyle, Camden, and [illegible]
Maryland	New England	
Mayo	Peel and Uralla	Tingha.
Megalong	Bathurst	
Merrigalah (part of)	Peel and Uralla	Gyra River.
Metz	do do	do
Do (part of)	do do	do
Mickimill	Cobar	Bogan.
Milring (part of)	Albert	Albert.
Mingelo do	Mudgee	Tomingley.
Mitchell	Peel and Uralla	
Do (part of)	do do	Kookabookra and Oban.
Molroy	do do	Bingara.
Mongarlowe	Southern	Mongarlowe River (partly).
Moonan (part of)	Peel and Uralla	Upper Hunter.
Moorkale	Albert	Albert.
Moquilamba	Cobar	Bogan.

MINING DISTRICTS—*continued.*

Parish, or part of.	Mining District.	Gold-field.
Moruya	Southern	Moruya (partly).
[illegible]	Mudgee	
[illegible]	Bathurst	
Mount Allen	Cobar	Bogan.
Mount Gipps	Albert	Albert.
Mount Hope	Cobar	Bogan.
Muckerwa (part of)	Tambaroora and Turon	Macquarie River, Stony Creek, Ironbarks, and Muckerwa.
Do do	do do	do do
[illegible]	Lachlan	Billabong.
[illegible]	New England	Emmaville.
Mulgunnia	Bathurst	Mulgunnia and Abercrombie (partly).
Mount Mundi	Albert	Albert.
Mungabarina	Tumut and Adelong	Black Range (partly).
[illegible]	Cobar	Bogan.
[illegible]	Peel and Uralla	Bingara.
[illegible]	Albert	Albert.
[illegible]	do	do
[illegible]	Southern	Argyle, Camden, and King.
[illegible]	Bathurst	
[illegible] (part of)	Southern	Gulph (partly).
[illegible]	do	Nerrimungah Creek.
New England Mining District.		
[illegible]	Peel and Uralla	Ironbark and Tea-tree (partly).
Do	Hunter and Macleay	Orara.
[illegible]	Southern	Dromedary.
Do (part of)	do	do
[illegible] do	Albert	Albert.
[illegible]	Clarence and Richmond	Boyd or Little River (partly).
[illegible] (part of)	Peel and Uralla	Peel River (partly).
[illegible]	Clarence and Richmond	Tweed and Richmond Rivers.
[illegible] (part of)	Southern	Shoalhaven and Shoalhaven River.
Oberon	Bathurst	Oberon.
[illegible] (part of)	Peel and Uralla	Upper Hunter.
[illegible]	Hunter and Macleay	
[illegible]	Peel and Uralla	Upper Hunter.
[illegible]	Albert	Albert.
[illegible]	Southern	Argyle, Camden, and King.
[illegible] (part of), Mount Brown	Albert	Albert.
[illegible]	do	do
[illegible]	do	do
Paradise North	New England	Emmaville.
[illegible]	Lachlan	Billabong.
[illegible]	Albert	Albert.
[illegible] (part of)	Peel and Uralla	Upper Hunter
[illegible]	Albert	Albert.
[illegible] (part of)	New England	Emmaville.
[illegible] do	do do	Boorook and Lunatic
[illegible]	Albert	Albert.
[illegible] Glen	New England	Emmaville.
[illegible]	do do	do
[illegible] (part of)	do do	* do
[illegible] Valley do	Tumut and Adelong	Umaralla.
[illegible]	New England	Boorook and Lunatic (partly)
[illegible]	Peel and Uralla	
[illegible] (part of)	do do	Kookarabooka.
Do do	do do	do
[illegible]	Cobar	Bogan.
[illegible]	Peel and Uralla and New England.	Emmaville (partly).
[illegible]	Peel and Uralla.	
Sebastopol	Tumut and Adelong	Sebastopol, Junee, and Urangilly (partly).
Do	Albert	Albert.
[illegible] (part of)	Peel and Uralla	Kookarabooka.
[illegible]	Albert	Albert.
[illegible] (part of)	Peel and Uralla	
[illegible] Grove (pt. of).	New England	Emmaville (partly).
[illegible]	Peel and Uralla	Tingha do
[illegible]	Tambaroora and Turon	Turon River.
[illegible] (part of)	Bathurst	Gully Swamp and Black Hills (partly).
[illegible]	Cobar	Bogan.
[illegible]	Albert	Albert.
Southend	Southern	
South Gundagai	Tumut and Adelong	Adelong Creek and Gundagai.

Parish, or part of.	Mining District.	Gold-field.
Springbrook	Clarence and Richmond	Boyd or Little River.
Stanford	Hunter and Macleay	
Stephen	Albert	Albert.
Stockington	Hunter and Macleay Extended.	
Stockton	Hunter and Macleay	
Do (town of)	do do	
Stonehenge	Peel and Uralla	
Stowell	Hunter and Macleay	
Strachan	New England	Emmaville (partly).
Strathbogie	do do and Peel and Uralla.	do do
Do North	New England	do do
Strathspey (part of)	do do	Boorook and Lunatic.
Sutton	Hunter and Macleay	
Swinton	Peel and Uralla	Tingha.
Talbragar	Mudgee	Gulgong.
Tallaganda (part of)	Southern.	
Tambaroora do	Tambaroora and Turon	Wellington.
Tara	Albert	Albert.
Telerarce	Hunter and Macleay	Gloucester (partly).
Tenandra	Mudgee	Mitchell's Creek.
Tent Hill	New England	Emmaville (partly).
Teralba	Hunter and Macleay	
Thornshope	Bathurst	Mount Lambie.
Tienga	Peel and Uralla	
Timbarra	New England	Boorook and Lunatic, and Timbarra.
Tomago	Southern	Mogo (partly).
Tomaree	Hunter and Macleay	
Toogong	Lachlan	Cargo and Canowindra (partly
Topi Topi	Hunter and Macleay	Gloucester.
Torrowangee	Albert	Albert.
Torrens (part of)	Bathurst	King's Plains.
Tont	Cobar	Bogan.
Triamble (part of)	Tambaroora and Turon	Wellington.
Trigalong	Lachlan	Temora.
Tuena	Bathurst	Abercrombie.
Tuggarah	Hunter and Macleay	
Tumbarumba	Tumut and Adelong	Tumbarumba, Ourance, and Burra Creek (partly).
Undercliff (part of)	New England	Boorook and Lunatic.
Umbo do	Tumut and Adelong	
Umberumberka	Albert	Albert.
Ulmarrah (part of)	Tambaroora and Turon	Wellington.
Urabadalla do	Southern	
Walcha	Peel and Uralla	Swamp Oak and Niangala.
Wallah Wallah	Lachlan	Lachlan.
Wallundry	do	Gundabindyal.
Walters (part of)	Tambaroora and Turon	Wellington.
Wangat	Hunter and Macleay	Gloucester.
Warragamba	Bathurst	
Warratra (part of)	Mudgee	Wellington.
Warre Warral	Tumut and Adelong	Sebastopol, Junee, and Urangilly.
Waukāroo	Albert	Albert.
Wellington North	New England	Emmaville (partly)
Wellington Vale	do do	do do
Walls	Tambaroora and Turon	
Wertago	Albert	Albert.
West Fairfield	New England	Timbarra.
Willie Ploma	Tumut and Adelong	Adelong Creek.
Willyama, (village of)	Albert	Albert.
Windeyer (part of)	Mudgee	Wellington.
Wonona	Southern	
Wongawilli	do	
Wood's Reef	Peel and Uralla	Ironbark and Tea-tree.
Woraro	Albert	Albert.
Worcester	Bathurst	Ophir.
Worra	Peel and Uralla	Kookarabooka.
Wyaldra	Mudgee	Gulgong.
Wyanbene	Southern	
Wylie	New England	Boorook and Lunatic (partly).
Yalwal (part of)	Southern	Yalwal.
Yancowinna	Albert	Albert.
Do North	do	do
Yarralaw	Southern	Argyle, Camden, and King
Young (part of)	Lachlan	Burrangong.
Yowaka	Southern	Pambula.
Do (part of)	do	do

GEOLOGICAL MAPS AND PUBLICATIONS ISSUED BY THE DEPARTMENT OF MINES AND AGRICULTURE, SYDNEY.

(1.) MAPS.

Map showing Mineral Areas of New South Wales. Scale, 16 miles to 1 inch.
Do do do Scale, 50 miles to 1 inch.
Geological Sketch Map of New South Wales, compiled from the Maps of the late Rev. W. B. Clarke, M.A., F.R.S., by C. S. Wilkinson, L.S., F.G.S., Government Geological Surveyor-in-charge. Scale, 8 miles to 1 inch.
Do do do do Scale, 22 miles to 1 inch.
Do do do prepared under the direction of E. F. Pittman, &c., &c., Government Geologist. Scale, 16 miles to 1 inch.
Geological Map of the Districts of Hartley, Bowenfells, Wallerawang, and Rydal, by C. S. Wilkinson, L.S., F.G.S.
Geological Map of Hill End and Tambaroora, by E. F. Pittman, Geological Surveyor.
Geological Map of the Vegetable Creek Tin-mining District, by T. W. E. David, B.A., F.G.S., Geological Surveyor. Scale, 58 chains to 1 inch.
Index Map of the Vegetable Creek Tin-fields, by T. W. E. David, B.A., F.G.S. Scale, 80 chains to 1 inch.
Geological Map of the Forest Reefs District, by H. Y. L. Brown, Geological Surveyor.
Map of the Silver-mining Country, Barrier Ranges, by C. S. Wilkinson, L.S., F.G.S.
Vertical Sections of New South Wales Upper Coal Measures, by John Mackenzie, F.G.S., Examiner of Coal-fields.
Diagrams showing the Thickness, Character, and Portion mined out of Coal-seams in the Coal Measures of New South Wales, by John Mackenzie, F.G.S., Examiner of Coal-fields.
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